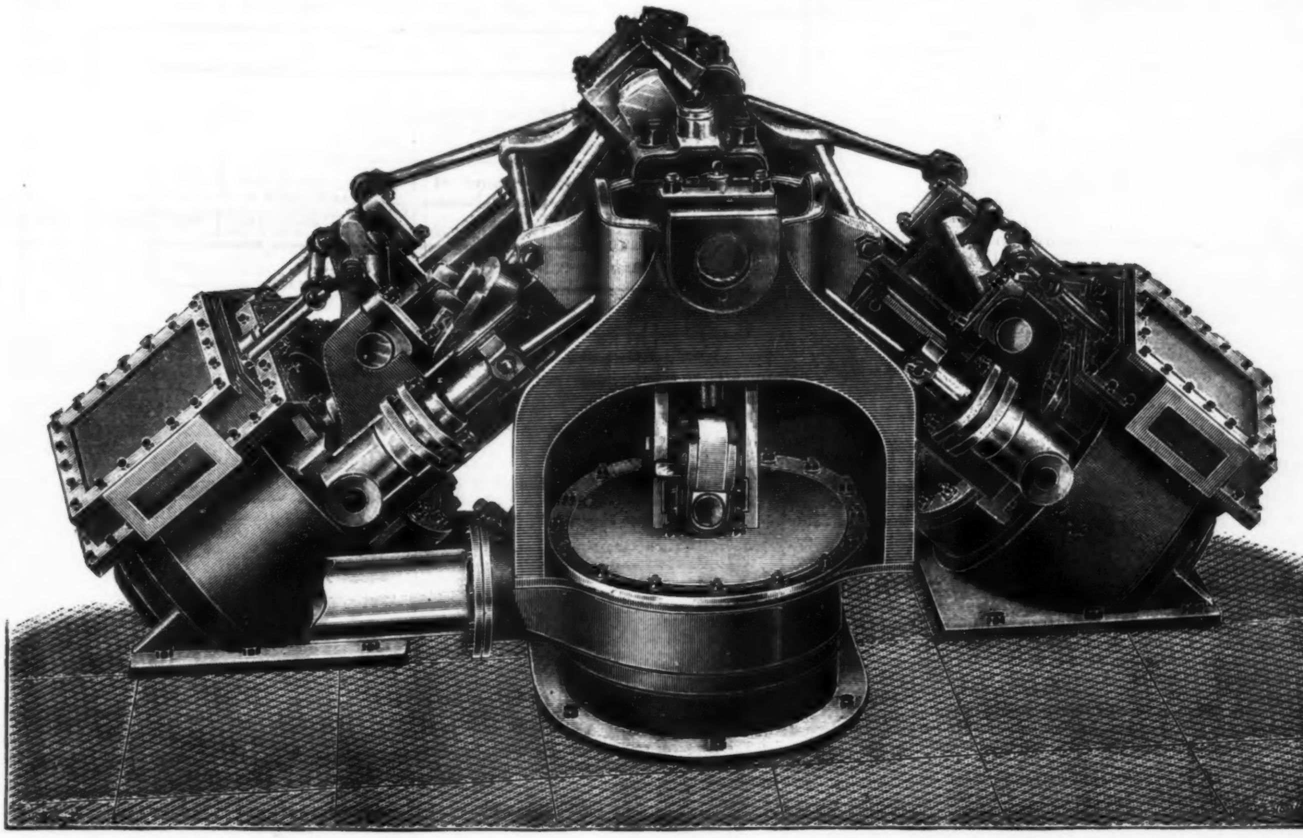
SCIENTIFIC AMERICAN SUPPLEMENT. No. 1168

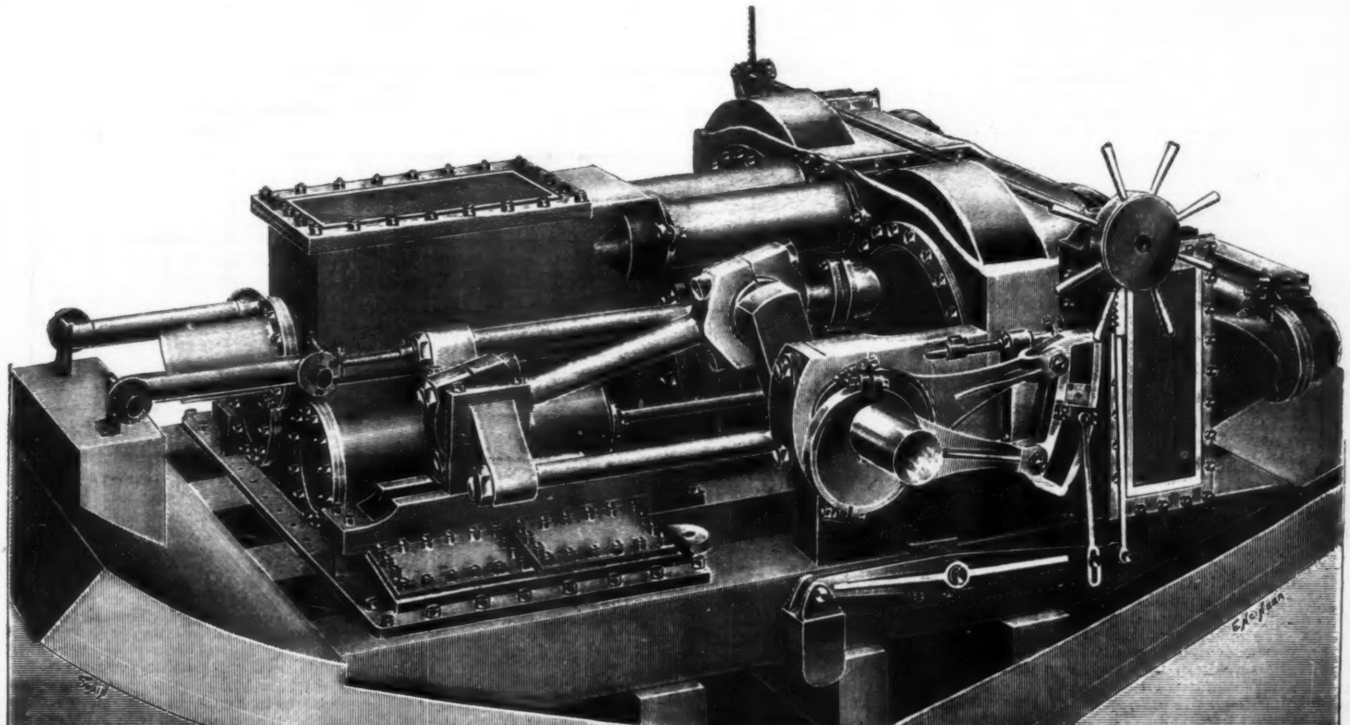
Scientific American, established 1845.
Scientific American Supplement. Vol. XLV. No. 1168.

NEW YORK, MAY 21, 1898.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.



ENGINES OF "HARBINGER," "BOSPHORUS," ETC.



ENGINES OF "VIPER," "WRANGLER," ETC.

MARINE ENGINES FOR COLONIAL LINE STEAMERS BUILT IN ENGLAND.

WE publish herewith an illustration of the propelling engines fitted by Messrs. Maudslay, Sons & Field to several of the Cape and Australian mail steamers, notably to the "Bosphorus" and the "Harbinger," as they were the pioneer vessels on the two routes, the first having opened the line to the Cape of Good Hope, and the other to Port Philip, Victoria. When giving in the article above mentioned the origin of the "Harbinger," an error has, we find, inadvertently crept in. The "Recruit," built by Mr. Ditchburn, and afterward converted by him into the mail steamer, was originally a man-of-war sailing brig, and not the paddle steamship of the same name, which was a later addition to the navy.

In proof of the excellent sailing qualities of the Cape boats, the first to be dispatched, it is worthy of note that the "Bosphorus," on her first voyage out, ran 215 miles in twenty-four hours—8 knots an hour—without steam, her screw being feathered during the time, but capable of being replaced in steaming position in one minute, on the wind dropping. The illustration we give of the engines fitted in her will, with our previous brief description, show the simplicity of design and compactness of their arrangement, together with the small space they occupied in the ship. As the engines of these pioneer vessels were merely auxiliary to their sail power, they were fitted with a single air pump, driven as shown in the illustration. In Fig. 2 we give a similar illustration of the type of engines, fitted by the same makers as those of the "Bosphorus," in the armed wooden dispatch boats "Viper" and "Wrangler," built for service at the time of the Crimean war, and described by us in our last article. With that description, and the details of arrangement shown in our engraving, the reader will be able to appreciate the care taken by their makers to have all the necessary gear for their prompt and efficient handling within easy command of the engineer on the starting platform.—The Engineer.

[Continued from SUPPLEMENT, No. 1167, page 18674.]

A METHOD OF MEASURING THE PRESSURE AT ANY POINT ON A STRUCTURE, DUE TO WIND BLOWING AGAINST THAT STRUCTURE.*

By FRANCIS E. NIPHER.

ABOUT 1,500 independent measurements were made upon the pressure board. It was decided to make a very thorough determination of pressures along the middle lines of the board. Such observations were made along the horizontal line of squares from 1 to 12, e, Figs. 3 and 4, and along the two vertical rows, a to i, 6 and 7. In addition, the half of the board furthest from the axis was well explored, and observations were made at a few symmetrically located points in the other half of the board in order to detect any substantial difference which might exist. It was to have been expected that slight flexures of the board might result in some differences in the lateral halves, although no appreciable difference was found. It was, however, found that the dragging of air along with the train caused the pressures on the front side to be greater at the top than at the bottom of the board. This effect was least when strong winds blew across the trains. It was also found that the rarefaction was greater near the bottom than near the top on the back side of the board. This was doubtless due to the obstructing effect of the car roof.

Fifteen observations of pressure in any square were usually taken at one time and the collectors were then removed to another. In the tables which follow the means of these observations are given. Where several determinations are given for the same square, they were usually made on different days. Some discrepancies appear which seem too large, but all observations have been included. The tremendous shocks which our improvised laboratory sometimes received made it necessary to exercise constant vigilance in detecting loose adjustments, and some sources of error have doubtless escaped us.

It was found that increase of pressure on the front side of the board and decrease of pressure on the back side were linear functions of the total force required to hold the board to the wind, as measured by the spring balance. If F represent the pull of the spring balance on an arm of 3 feet, h_1 the increase in the scale reading of gage No. 3 above the datum reading, 40·0 and h_2 the decrease of gage reading of No. 4, below 40·0, then for the front and rear pressures we have respectively,

$$h_1 = A_1 F$$
$$h_2 = A_2 F$$

where A_1 and A_2 are constants, A_2 being essentially negative. They denote the increase or decrease of scale reading per pound of pull on the spring balance. A_1 and A_2 are reduced to vertical water column by multiplying by 0·05. This may be taken as the pressure in grammes per square centimeter. The correction for density of water is about half of one per cent., and is slightly overcompensated by the change of level in the cistern. The further factor 2·048 reduces the pressures to pounds per square foot. The factor for reducing A_1 and A_2 to pounds per square foot is therefore 0·1024.

The values of A_1 and A_2 have been entered in the proper squares on diagrams of the front and the back of the pressure board. Such diagrams are shown in Figs. 3 and 4. The board was divided into strips where the conditions were evidently similar, and the average of observed values made in this area was determined. Thus, in the row of squares adjacent to the edge, the top line of squares constitutes such an area. These squares are marked 1 to 12, a. The line of squares 1 to 12, i, is another such area. The averages in the vertical rows a to i, 7, and a to i, 12, were also separately found.

The average value for such areas was then entered in all the squares of the areas, excepting that the values in the corner squares were smoothed a little, in order to make adjoining side rows unite with each other. Over these corner squares the pressures diminish in two directions toward the nearest edges of the board. In such cases the integrated pressures must therefore be less than in squares removed from the corners.

In like manner the averages in the second row of squares from the edges were determined. In this row the squares 2 to 11, b; 2 to 11, h; b to h, 2; and b to h, 11, were separately treated. The data contained in the table may be used by anyone to repeat these computations. The results for each square on the board are entered in Figs. 3 and 4, where the values have all been multiplied by 100. The values in Fig. 4 are, of course, negative in sign. These values therefore correspond to a spring balance reading of 100 pounds, when the arm is 3 feet. The moments of the forces applied to these 4-inch squares with respect to the axis of rotation have been summed. It was assumed as sufficiently exact, that the center of pressure for each square of $\frac{1}{9}$ square foot was at its center. The arm for the vertical row, a to i, 1, is $\frac{1}{6}$ foot, the arm for vertical row a to i, 2, is 1 foot, etc. The sum of the moments for the front and back sides of the board was found to be:

Front	169
Back	128
Total	297
By the spring balance	300
Difference	3

A difference of 1 per cent.

The sum of the 108 values for pressure on the front side, each multiplied by the area to which it applies, viz., $\frac{1}{9}$ foot, is 66·98 pounds. For the back side it is 51·76 pounds. The total force to be applied at the center of pressure is therefore 118·7 pounds.

For the location of the center of pressure, we have for the front and back sides, respectively,

$$\text{Front, } \frac{\Sigma\, Fl}{\Sigma\, F} = \frac{169}{67·0} = 2·52.$$

$$\text{Back, } \frac{\Sigma\, Fl}{\Sigma\, F} = \frac{128}{51·8} = 2·47.$$

The center of pressure for the front side of the board is in vertical row 7, and 0·02 foot from the middle line of the board. For the back side it is in row 6, and 0·03 foot from the middle line. These pressures would therefore practically balance on the middle line.

Summing the moments of the pressures with respect to the upper edge of the board, the center of pressures is likewise found to be below that edge a distance:

For the front side 17·1 inches.
For the back side 18·6 inches.

On the front side the center of pressure is above the middle horizontal axis, a distance 0·9 inch, while for the back side the center of pressure is below that line by 0·6 inch.

The resultant center of pressure is therefore slightly above, but very near the center of the board.

The completeness with which the indications of the collector and gage check against the spring balance is doubtless due in some degree to accident. It may be worthy of remark that the first reduction gave for the sum of the moments over the board a value 340, instead of 297, as before given. The reduction of all the original observations was then repeated, and the distributed pressures shown in Figs. 3 and 4 were carefully considered. There appeared to be no justification for any change which could affect the result by more than a fraction of 1 per cent. After several unhappy days, in which the advisability of publishing anything concerning the disk collector was under serious consideration, it was finally discovered that in reducing from grammes per square centimeter to pounds per square foot, a factor 0·1174 had been used instead of 0·1024.

An inspection of Fig. 3 will show that there is some evidence of a minimum of pressure at the center of the front face. This may be due to the effect of the hinges which cover the horizontal rows, b and h, although this is not regarded as very probable. It is not probable that this is wholly due to errors in observation.

The results shown in Fig. 3 also furnish a method of determining a value of considerable historical and theoretical interest. The average pressure on a board held normally in any fluid stream, due to the compression on the front and rarefaction on the back side, is

$$P' = K \frac{\delta}{2} v^2 \qquad (3)$$

instead of being represented by equation

$$P = \frac{\delta}{2} v^2 \text{*}$$

The value, K, is independent of any friction or viscosity in the fluid. It is the same for water as for air. It involves simply inertia in resisting a change of direction in passing the edge of the plate. Many determinations of this value have been made. In some cases in which the stream was water, the pressures before and behind the board have been measured by pressure columns.†

The values obtained by various experimenters are given in a table. The rotation experiments of Borda, Hutton and Thibault are said by Unwin to have been made on a long arm, but the lengths are not given. In Langley's experiments, the radius was 9 meters. His result is the mean of 14 determinations made with an automatic recorder.

If we may assume the value 7·17 pounds per square foot at the middle of the front side of our pressure board (Fig. 3) to be the pressure due to the velocity with which the board moves through the air, computed by Newton's theorem, we may then determine K. The total effective force against the plane we have found to be 118·7 pounds. Since the area was 12 square feet, the average pressure is 9·89 pounds per square foot. Hence K = 9·89 ÷ 7·17 = 1·37.

The pressures in Fig. 3 correspond to a balance pull of 100 pounds on an arm of 3 feet. This is equivalent to a force of (3 ÷ 2·5) 100 = 120 pounds at the center of pressure. The pull per square foot is, therefore, 10 pounds. This gives a value for K of 10 ÷ 7·17 = 1·39. This value is only in part determined from data independent of that involved in the other determination.

	1	2	3	4	5	6	7	8	9	10	11	12
a	4.00	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.00
b	4.30	5.00	5.90	5.94	5.94	5.94	5.94	5.94	5.94	6.00	5.90	3.99
c	4.30	5.94	6.50	6.96	6.96	6.96	6.96	6.96	6.96	6.20	6.14	3.99
d	4.30	5.94	7.48	6.90	7.48	7.48	7.48	7.48	6.96	6.55	6.14	3.99
e	4.30	5.94	7.48	6.96	7.17	7.17	7.17	7.17	6.96	6.55	6.14	3.99
f	4.30	5.94	7.48	7.00	7.48	7.48	7.48	7.48	6.96	6.55	6.14	3.99
g	4.30	5.94	6.50	7.37	7.37	7.37	7.37	7.37	7.37	6.30	6.14	3.99
h	4.30	4.30	5.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	3.99
i	3.00	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.30

FIG. 3.—FRONT OF THE PRESSURE BOARD.

	1	2	3	4	5	6	7	8	9	10	11	12
a	3.00	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.70	3.00
b	4.30	4.40	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.99
c	4.30	4.61	4.70	4.20	4.20	4.20	4.20	4.20	4.20	4.10	3.99	3.99
d	4.30	4.61	4.91	4.40	4.30	4.30	4.30	4.30	4.60	4.61	3.99	3.99
e	4.30	4.61	4.91	4.61	4.61	4.61	4.61	4.61	4.81	4.61	4.61	3.99
f	4.30	4.60	4.70	4.81	4.61	4.61	4.61	4.61	4.61	4.80	4.61	3.99
g	4.30	4.60	5.00	5.02	5.02	5.02	5.02	5.02	5.02	4.80	4.60	3.99
h	4.30	4.80	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.80	3.99
i	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.00	3.50

FIG. 4.—BACK OF THE PRESSURE BOARD.

* Lecture before the Academy of Science of St. Louis and reprinted from vol. viii., No. 1, of the Transactions of the Society.

* See first part of this article, in previous issue.

† Hydromechanics. Enci. Brit., 517. Report chief signal officer, 1887. 2:223

K.	Authority.	Medium.	Area of plate sq. ft.	Remarks.
1·39	Borda	Air	0·13	Rotation
1·49	"	"	0·25	"
1·64	"	"	0·63	"
1·24	Hutton	"	0·13	"
1·43	"	"	0·25	"
1·525	Thibault	"	0·25	"
1·784	"	"	1·11	"
1·433	Dubuat	Water	1·0	Still water rect. v = 3 to 6½ feet per second
1·36	Morin Piobert & Didion	Air	0·3 to 2·7	....
2·18	"	Water	"	Vertical motion shallow tank
1·25	Mariotte	"	....	....
1·856	Dubuat	"	....	Plate stationary, stream of water
1·834	Thibault	Air	1·17 to 2·5	Wind power
1·31	Langley	"	1	Rotation v = 4 to 11 meters per second

If, instead of taking the pressure at the middle of the pressure board, we take the average pressure over the front face, we have by the spring balance determination of pull, K = 10 ÷ 5·58 = 1·79, which agrees very *well* with some of the higher values of K determined by others. It is, however, evident that this value of K is theoretically a wholly different quantity from that which we seek to determine.

It seems entirely possible that the pressure at the center of the board is less than that which corresponds to the average (velocity)² with which the wind sweeps past the board, as computed by the Newton theorem. The determination of this wind velocity is a problem of much greater difficulty than at first sight may appear. If we assume 7·48, the highest pressure on the board, to correspond to this velocity, the value of K becomes 10 ÷ 7·48 = 1·34.

The spring balance and pressure collector deal with the pressures which really affect the pressure board, regardless of the complexity of air currents. In this respect they differ essentially from the tube collector attached to the wind vane.

In illustration of this point I may relate one incident of our work which happened after our pressure board work was finished. It was observed on starting on one of our trips that the gage attached to the cup collector on the wind vane showed little if any increase in pressure. As the speed increased, it began to show an exhaust, which seemed to increase with the speed. Every part of the pressure circuit was examined and no cause could be found for the result. Finally, it was observed that, unnoticed by us, a refrigerator car had been placed in front of us, and it was thought possible that the open trap door in the roof of this car might be the cause of the trouble. The door was 33 × 35 inches and was opened to an angle of 33°. Its distance from the wind vane was 11 feet. The door was shut down, and the gage reading increased 20 centimeters in a couple of seconds. This door had deflected the air stream upward, and it had descended in a cascade upon our car. The lines of flow must have made a somewhat greater angle than 60° with the horizontal axis of the tube collector. It is because of such experience that no use has been made of a great mass of data involving velocities. This material will be used in a future paper dealing with the effects of the train on the air around it.

The results of this investigation seem to fully justify the use of the disk collector in a study of the distribution of pressure on large buildings. An arrangement which I have found very satisfactory may be briefly described. A window is raised a couple of inches and a wooden bar capable of longitudinal extension is placed in the opening thus formed. A ⅜ inch brass tube connecting with the pressure gage passes out through a hole in the bar. Outside, this tube enters a similar tube at right angles to the former and forming the arms of a T. From the ends of these arms short tubes return to the wall of the building and serve as feet for holding the conducting tube in position when it is pulled into position from within. The ends of the feet should be plugged, and one of them should be adjustable, to provide for inequalities in the wall surface. The end of one arm of the T should also be closed. From the other a tube extends 6 or 8 inches and an elbow and tube return toward the building and carry the pressure collector. The plane of the collector is parallel to the surface of the wall, and should be 1 or 2 inches from it. Collectors should be placed over the various walls of the building and upon its roof. The tubes should be adjusted to the same resistance and as nearly as possible to the same capacity, so that all will respond with equal quickness. The gage tubes should be parallel and side by side, so that they may be photographed at any instant when a heavy gust of wind is blowing. The gage tubes should, of course, lead into a tank, connecting by a large tube with a large Abbe collector above the roof. This collector should be high enough above the roof to escape the effect of the building. The stream lines should be horizontal where this collector is placed. Near the summit of inclined roofs, on the windward side, and over the entire leeward side, the pressure is reduced by a wind. On a flat roof the pressure is always reduced. The pressure is less than that of the atmosphere, and this reduction of pressure increases with an increase in velocity. The standard pressure should be collected from a point above these disturbances.

When the wind blows at right angles to one side of a building, the pressure on all other sides is diminished. If a window yields on the windward side, the pressure within the house will be increased. The tendency is to lift off the roof and throw three walls outward. The windward wall is often braced by partitions, so that it is less likely to fall in than the others are to fall out. I believe that it is possible to greatly increase the resisting power of ordinary farm buildings against wind without materially increasing their cost. But it is very desirable to determine what these pressures really are.

The observations on pressures should be supplemented with simultaneous observations on wind directions. A vane with a cup collector connected with a gage below will determine pressure, due to the free wind, from which velocity may be computed.

Two metal brushes 180° apart are attached to two insulated rings surrounding the vane tube. The poles of a battery connect with these rings by sliding contact. A flat commutator with 72 segments surrounds the tube and the two brushes slide upon it, touching opposite segments. The wires lead in a cable to the closed copper windings on an iron ring at the pressure gages. The wires of the cable connect to these windings at equidistant points, those coming from opposite commutator bars leading to opposite points in the winding, and adjacent wires at the commutator being adjacent at the ring. The arrangement is exactly that of the Gramme armature. The polarity of the ring will follow the shifting of the vane. A magnetic needle, whose pivot is at the center of the ring, will follow the vane. This needle may be photographed with the scales. With comparatively small expense, it will be easy to obtain information of great value, even with ordinary winds. At some of the mountain observatories destructive winds are not uncommon, and it is desirable that such work should be undertaken there. In conclusion, I wish to express my grateful thanks to Prof. Timmerman and Mr. Schlossstein for their enthusiastic aid under circumstances which were very far from inviting to one seeking rest and quiet. My thanks are also due to Mr. Stuyvesant Fish and Mr. A. W. Sullivan, president and general superintendent of the Illinois Central Railroad, through whose co-operation we were enabled to do the work, and to Mr. Joseph Boyer for the loan of his speed recorder. There are dozens of others who have assisted us greatly in various ways whom I cannot name. The names of some of them I do not even know. But it was a constant pleasure to receive their aid, and I feel that much of the success we may have attained was due to such friendly assistance.

Reference has been made to an uncorrected error in displacement of the zero point. This is a differential error, due to differences in the gage tubes. The correction is practically all involved in the factor 0·05.

THE USE OF ALUMINUM IN BICYCLES AND LIGHT MACHINERY.

OWING to recent methods which have been perfected in working and casting aluminum into small articles for replacing brass and other metals, its general use in construction of bicycles and light machinery has become quite extensive. The advances which have been made, especially in drop forging, are quite worthy of attention, and it is possible to make a large variety of articles by this method which have heretofore been made of steel or iron. The drop forging of aluminum not only gives better shapes, but of greater solidity, and the work which is thus put upon the metal adds materially to its tensile strength. It is a well known principle in the use of all metals, that articles which are wrought are stronger than cast articles, and when the work is added which is obtained in drop forging, the strength is still further increased. All metal used for drop forging is first rolled or drawn, or has some work done upon it.

Quite a number of experiments have been made in manufacturing bicycle pedal frames from aluminum by drop forging them, and they have proved very successful owing to the lightness of the metal, the color, and the ease with which they can be made. This same process of manufacture can be extended to the brake shoes, brake handles, handle bars, etc. There is also a large variety of articles which can be manufactured from castings which cannot be drop forged, owing to their complicated shape.

In drop forging aluminum the dies should be made with considerable clearance and vaseline used as a lubricant. Naturally there is not as much force required to work aluminum as in drop forging steel, and less time is consumed in making the forging. Care should be taken, however, to use plenty of lubricant, so the metal will not stick to the dies. The effect of alloying aluminum which is to be drop forged is to harden the metal considerably, the higher alloys giving the best results up to 15 per cent. of alloying material. No zinc should be used in alloying aluminum which is to be drop forged, because the tendency of zinc is to make the metal brittle.

The use of aluminum also has entered extensively into the manufacture of the various parts of bicycle lamps and their fastenings by which they are connected to the machine. There are some lamps on the market which are made entirely of aluminum, and quite a number which have the reflectors and other light parts made of this metal. Here it might be mentioned in connection with making these castings, that in the manufacture of different shapes, especially large flat surfaces, considerable care is required in order that the shrinkage may not be excessive, also that the mould is sufficiently well vented to allow for the escape of all occluded gases. The shrinkage is best taken care of by using on any projecting part of the casting a riser sufficiently large, and also to be careful to have the gate of such a size that the metal in the body of the casting will cool before it cools in the gate, then allowing the molten metal in the gate to flow in and supply the shrinkage in the main part of the casting. It is also desirable in casting flat surfaces to have the flask tilted in such a manner that the gases on the under side will have all possible chance to escape.

Owing to the fact that aluminum is so much lighter than other metals, these gases, in many instances, get in between the sand and the metal, and it is necessary that these gases have every facility for escaping, as the pressure to force them out in casting aluminum is not as great as in casting other metals. The use of aluminum in high speed machinery, such as centrifugal machines, is attracting a considerable amount of attention, owing to the fact that the bursting of the revolving part of such machines is directly in proportion to its mass or weight multiplied by the square of the velocity, and, consequently, if the weight is reduced, the strain on the metal is proportionately reduced. In machines which are used for separating cream from milk, and also in the manufacture of beer, sugar, etc., it is quite an object to reduce to a minimum the weight of the revolving machinery. While the section of the part manufactured out of aluminum should possibly be increased over a similar section in brass, this increase is insignificant when compared with what is saved, and it is generally possible to save one-half of the weight of a revolving piece, thus reducing the tendency to fly apart one-half in comparison with machines running at the same rate of speed manufactured of other metals.

Aluminum is also finding an extensive use in the manufacture of typewriters. There is a machine on the market now which has all the levers made of aluminum, as they are more durable than wood or hard rubber, and lighter than steel—consequently more easily operated than a heavier metal. The use of aluminum in portable typewriting machines has proved an attractive feature, where weight is a great consideration. Some typewriter carriages have also been manufactured out of aluminum, and it is more than probable that the development along this line will be marked, owing to the fact that the reducing of weight makes general operation of the machine easier.

The use of aluminum in the small parts of telephones and telephone connections has come into quite general use. The transmitters of nearly all the long distance telephones are made of this metal, owing to the fact that the lightness of aluminum makes it more sensitive to the vibration which it is intended to take up and transmit. It is also found advisable in making many of the connections to use aluminum, owing to the fact that it does not oxidize under the ordinary atmospheric conditions, and a good contact between the metals is possible, whereas in the first machines that were made, after they had been in use a little while, these points of contact corroded, and the electrical connection was not made with the same facility or with the same degree of perfectness.

The metal is also replacing hard rubber to a large extent, not only in the telephone, but in the phonograph and similar machines. The metal can be cast in iron moulds, so that the surface is smooth and true, which saves the machine work which is necessary on the ordinary castings of this class, and when similar castings are thus made in iron moulds they can be made for about one-half the expense of an article manufactured from hard rubber.

In the uses of aluminum that have been mentioned the advantage to be derived has been principally from reducing weight. Another use is not so much to reduce weight as it is to give an increased strength to the part of machinery in question. The effect of a small percentage of aluminum added to brass is very noticeable. A small per cent., say from one-tenth of one per cent. to a half of one per cent., does not increase the strength materially, but it seems to purify the metal and makes it more fluid, thus allowing it to take the form of difficult and irregular castings. In light castings more pieces can be cast as a gate due to the increased fluidity. After the percentage of aluminum added to brass is increased over one-half of one per cent., the increased strength of the resulting casting is quite marked, and this increased strength continues until from ten to twelve per cent. of aluminum has been added.

This is called "aluminum brass," and approaches "aluminum bronze" in strength, this strength entirely depending on the quality and quantity of spelter which there is in the mixture. It is a well established fact that aluminum bronze is the strongest commercial metal, and the use of it in castings and certain machinery is only retarded by the cost of working it in the shop, such as cutting off gates, filing and turning it up. Owing to the peculiar close-grained nature of the metal, it makes a good bearing metal, not in replacing Babbitt, but where great strength is necessary with a small bearing surface, as in aluminum bicycles and other parts of small machines. It can be advantageously used for bushings and bearings in small, light work, where the weight of the revolving piece is small.

The methods of introducing aluminum into brass have been treated in former issues of this paper quite extensively, and it should always be introduced in the form of aluminized zinc.

Aluminum brass has found an extensive use where much drawing of the metal is required. The amount of aluminum for this purpose, however, should not be over from two to four per cent., depending upon the article to be drawn. It requires more force and more power to do this drawing, owing to the increased strength of the resulting metal, but the large gain of an increased strength is very marked. Aluminum bronze tubing has been manufactured successfully, containing as much as eight per cent. of aluminum, and a number of the brass mills are now using aluminum in their brass mixture, as a small percentage of this, as previously stated, seems to clear the metal of impurities and enable the manufacturer to produce a more perfect tube.

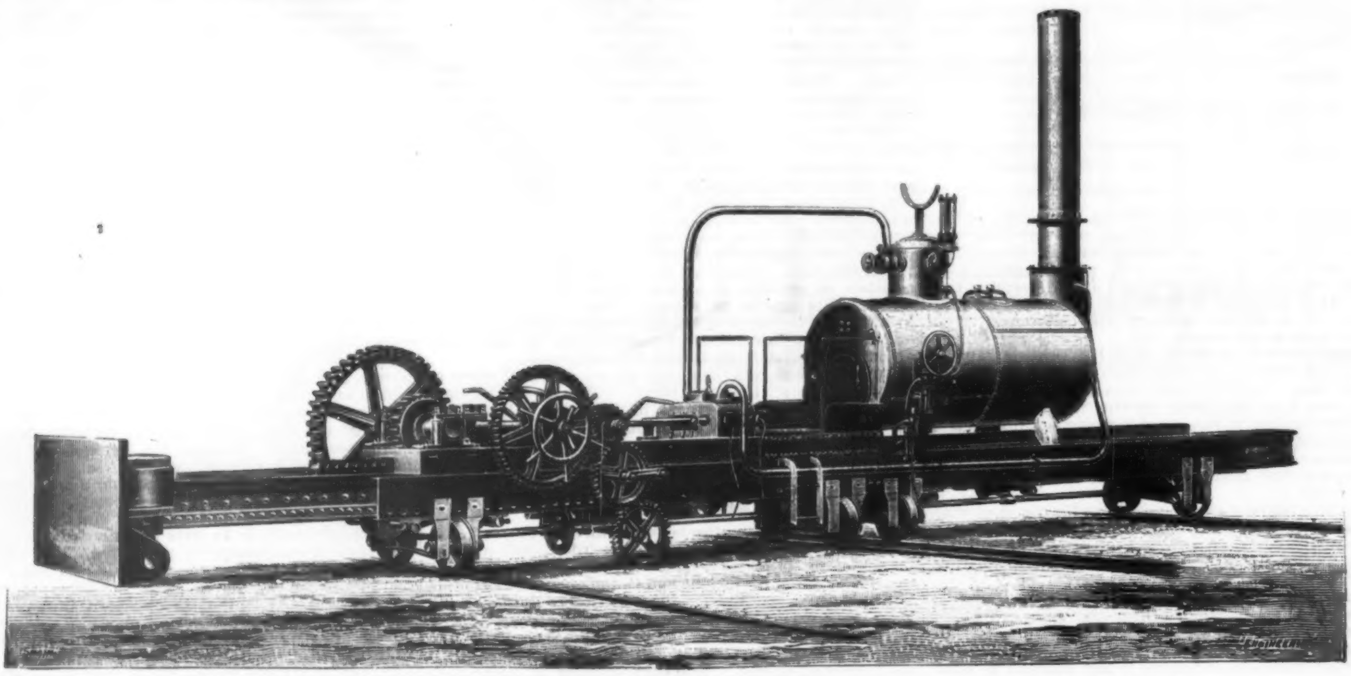
Aluminum has also found its way extensively into vibrating and reciprocating machines, both large and small. Here again the advantageous use of the metal is entirely a matter of reducing the weight. Probably the best illustration of the use of aluminum in revolving machinery is in using an oil cup on the driving-wheel of a locomotive in connection with a driving-rod. With the increased speeds that the roads are now aiming to attain, it is necessary to increase the diameter of the driving-wheels, and consequently the tendency to break the shank of the oil cups materially increases, and with some of the large engines which have been built, cups made of composition are frequently broken, owing to the fact alluded to in the first part of this paper in connection with centrifugal machines. These cups are now, and have been for some time, successfully cast in aluminum, and have given great satisfaction.

In the majority of the classes of machines manufactured out of aluminum, previously mentioned in this article, it is advisable to use bushings or bearings of aluminum bronze, steel, or some other hard, antifriction metal to take up the wear, as aluminum, generally speaking, does not stand well where the wear is excessive. In almost all cases the use of pure aluminum is to be avoided. The alloys of aluminum now on the market contain a very small per cent. of hardening ingredients, but the most successful results can be obtained by using some of these alloys, as the pure metal is too soft for the majority of purposes for which

it would be required in ordinary machinery. The best of these alloys, probably, is what is known commercially as "nickel alloy." There are other commercial alloys which can be used advantageously for special parts, and before going thoroughly into any particular case it will be desirable to take up the question of the best alloy to use with the manufacturers, and thereby gain what experience they have had in this particular direction, and conduct experiments on the use of the metal from this starting point.—Aluminum World.

JAPANESE MADE MACHINERY.

FOR some years the manufacturers in other countries have been in the habit of complaining bitterly of the wholesale manner in which the Japanese have been



COKE PUSHING MACHINE, ISHIKAWAJIMA SHIPBUILDING AND ENGINEERING WORKS.

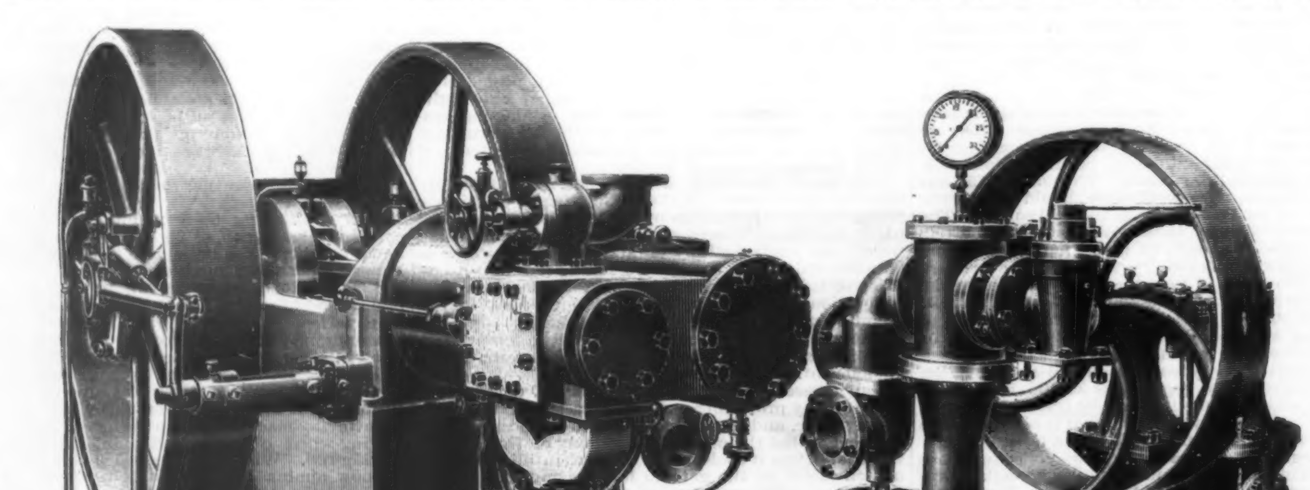
copying their machinery. At present this is a groundless cause of complaint, but, no doubt, in another ten or fifteen years the Japanese may be able to make a good many of the machines required in their ordinary arts. The Engineer, of London, with commendable enterprise, has sent out a commissioner to Japan to investigate the industrial and scientific status of that country. He states that up to the present time, although they have tried their hand at almost everything from bridge work to bicycles and from ships to sewing machines, the Japanese have, as a rule, hardly mastered the first problem of making good machinery on a large scale or on successful commercial lines. Engineering in Japan is a new industry, and it is hardly reasonable to suppose that the Japanese, with thousands of foreign inventions before them which work satisfactorily, which are not protected by patents, should, out of the spirit of Quixotic philanthropy, refrain from utilizing the experience of others and insist on their invention over again and that they themselves should wish to make what has already been patented. That would be following an idiotic policy, if they attempted to work on these lines. We would certainly not think it worth while to start making cloissoné ware or bamboo fans in England or America. If the English or American people decided to make such articles, the first thing they would do would be to send for the requisite number of Japanese artisans to teach the method of making these things, and, no doubt, as soon as we found that our men could get along without foreign assistance, the Japanese advisers would be sent away. This is the same principle as that on which the Japanese work. The Engineer's special commissioner points out that the real and legitimate grievance is that there is but little chance of getting their inventions patented in that country, as the patent laws are in a very unsatisfactory state. While Japan is supposed to be, and is, civilized, it is in many ways bound to neglect certain things, and the subjects which stand the best chance of being neglected are those in the tackling of which she can secure no particular advantage to herself. The defining of her patent law is one of these, and the Japanese government is aware that something will have to be done, but they are not taking the matter seriously at present, and it is favorable to the interest of foreign manufacturers to urge their governments to influence Japan in the matter as regards protecting bona fide inventions.

There are plenty of spinning mills, electrical works, mines, etc., in Japan, but there is hardly an up-to-date engineering works of any sort. The Japanese are very great hands at asking for advice and paying for it and then not following it, and they have had to pay for that privilege also. Young Japanese students who have just left the university do not hesitate to pronounce upon the merits of plants of all kinds, and if a student sees a belt running at an angle which one of his professors may have told him is not an ideal angle, or if he thinks the bearings should be further apart or nearer together, he will not hesitate to recommend alterations which will spoil the entire arrangement. A strange thing about it all is that the purchaser will very likely follow this young man's advice, although the chances are the latter has never seen any of the machines in question except on paper. All these things may account for the defectiveness of the Japanese engineering shops.

The Japanese employ strange methods in dealing with their work. A large proportion of the Japanese made machines are merely worthless, but some of the engineering products turned out in Japan are very creditable. We present two illustrations from The Engineer, showing machinery made either by the Ishikawajima or the Shibaura Engineering Works, both of them in Tokyo. They are not particularly interesting in themselves, but show what creditable work is really done by some of the large engineering works in Japan.

TECHNICAL TESTING STATIONS.

THE annual report of the Berlin testing station, not to be confounded with the Reichsanstalt at Charlottenburg, now a suburb of Berlin, which has also a technical department, well marks the varied character of the work carried on there. In the metal testing department we notice an increase in the number of experiments with finished constructive members. In order to facilitate the operations at the respective works, the Versuchsanstalt has started supplying control test bars which are to be returned from time to



JAPANESE HORIZONTAL ENGINE AND INDEPENDENT CONDENSER.

time for restandardizing. Carbonic acid cylinders were dropped on bars of pig through a space of 13 feet; several cylinders caved in, but none broke. Some cylinders for dentist's "laughing gas" gave poor results. For many experiments, notably those of building materials, such as large blocks of beton and stone, the 500 ton apparatus has been much in requisition. The very improperly called felt mats for preventing noise and vibration, to which we have referred, were also subjected to this pressure. One eminent firm of cement makers regularly sends up samples for examination. Very few bricks have been submitted for testing, but there has been a good number of artificial stones made with various slags. A disintegrated porphyry proved an excellent substitute for sand in cement. For cement conduits, long duration tests are almost indispensable. As novelties we mention experiments on so-called soluble vaseline, recommended as a lubricant, and on flexible shafts, made of several closely packed layers of wires, crossing under various angles, but not twisted. We should mention that many a trade dispute is settled by the reports of this body, and that the courts of justice frequently refer doubtful points to the decision of these official experts. The custom department with its vexatious regulations is also a customer of the Versuchsanstalt.

REPORT OF THE BUILDING COMMITTEE OF THE SCIENTIFIC ALLIANCE OF NEW YORK.

THE building committee reports as follows: The Scientific Alliance of New York is the outgrowth of several conferences of commissioners from all of the societies now included in the Alliance (except the Entomological Society, which was not then in existence, and also of the New York Branch of the Archæological Institute of America, which, however, did not enter the final organization), called by a committee appointed by the New York Academy of Sciences, in February, 1891, "to consider what methods might be adopted for mutual benefit and support." The first meeting of the commission was held at the American Museum of Natural History on March 11, 1891, and among the subjects discussed was "the desirability of obtaining a building for a common meeting place of all the societies." Thus, at the very outset of the movement, the idea of bringing the societies together under one roof was prominent in the minds of those who formed the Alliance.

At the first meeting of the council, September 28, 1891, the president was "requested to appoint a committee of seven, to consist of himself as chairman and one member from each of the allied societies to consider the practicability of obtaining a building for the use of the Alliance." Thus again the policy of seeking a common meeting place was made one of its main objects by the now fully organized federation.

On October 10, 1891, the building committee was appointed and from that time to this it has not ceased to consider every suggested scheme and to follow every possible clew which seemed to lead to the attainment of its object. At the meeting of the council held January 22, 1892, the committee presented its first report, in which it suggested three plans for consideration, as follows:

"(I) That the Alliance attempt to secure enough money by subscription to purchase land, erect a building and maintain it.

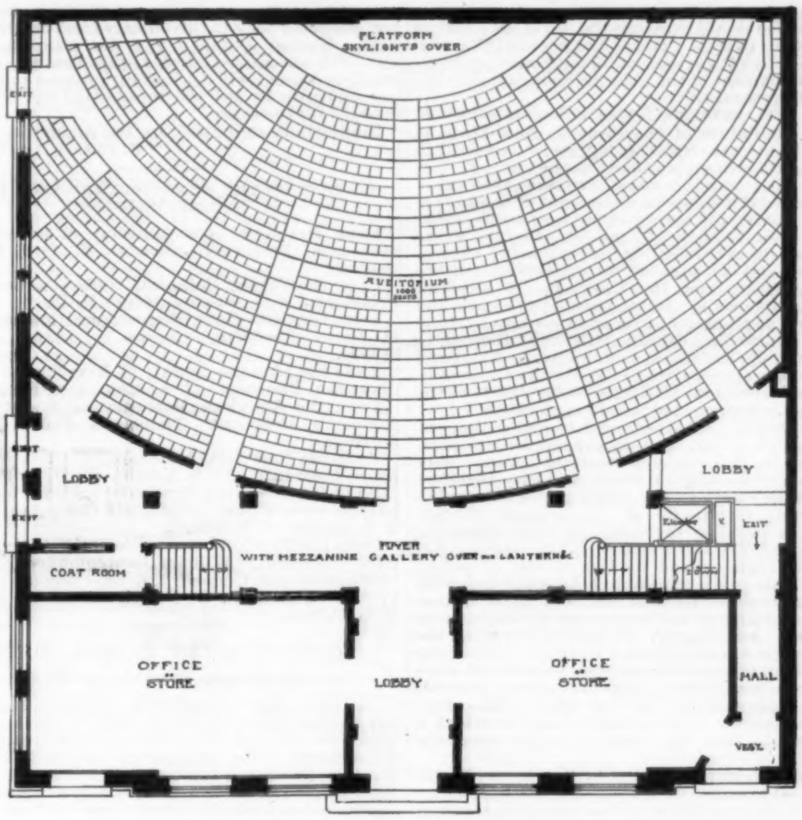
"(II) That the Alliance endeavor to obtain from the city or the State, money to erect a building on public land, which would necessitate the raising of a guarantee fund for the support of the building, which, obtained under these conditions, would belong to the city.

"(III) An informal suggestion from President Low, of Columbia College, that the Alliance should co-operate with the college in the erection of a building to be used jointly by the Alliance and the college."

The first of these plans was at the time considered impracticable, chiefly because of the financial depression then prevailing, and the continuance of the same condition has caused the committee to hold it in abeyance until now. The second plan had in contemplation an attempt to place the Scientific Alliance on a basis similar to that of the Museum of Natural History, assuming that the societies could render an equivalent for public aid by the maintenance of a scientific library and through courses of free lectures upon popular scientific subjects. The third plan, however, was the one which for the time being seemed to hold out the most hope of accomplishment and therefore met with the approval of the council. The idea underlying it was that when Columbia University should remove to its new site and should dispose of its property on Madison Avenue it would still need a downtown building for its offices and perhaps also as a place for certain of its lecture courses. The scheme the committee had in mind was to endeavor to raise a sum of money sufficient to pay one-half the cost of such a building, in consideration of which the council should have a perpetual use of a fair proportion of the rooms for the constituent societies, the title to the property to be taken by Columbia University. The council authorized the committee to confer with President Low upon some such basis and the matter was accordingly gone over with him, but without definite result.

Meanwhile the committee were informed that the trustees of the fund left by the late Samuel J. Tilden, for the foundation of a public library, would be willing to discuss the question of devoting that fund to the purposes sought to be accomplished by the Scientific Alliance, namely, the erection of a building for the use of the allied societies, the establishment and maintenance of a library of general science, the endowment of original research and the publication of scientific memoirs and other papers; the idea being to found an institution for New York which should combine the objects of Burlington House and the Royal Institution of Great Britain, with the addition of a department for the issue of a series of works similar to those published by the Ray Society and other learned bodies abroad. A number of interviews with the Tilden trustees, collectively and individually, subsequently took place, and, indeed, continued until the Astor, Lenox and Tilden foundations were united.

In September, 1892, your committee drew up a formal address to the Tilden trustees, setting forth in detail the plan above referred to, and this communication was adopted by the council, signed by all the members,

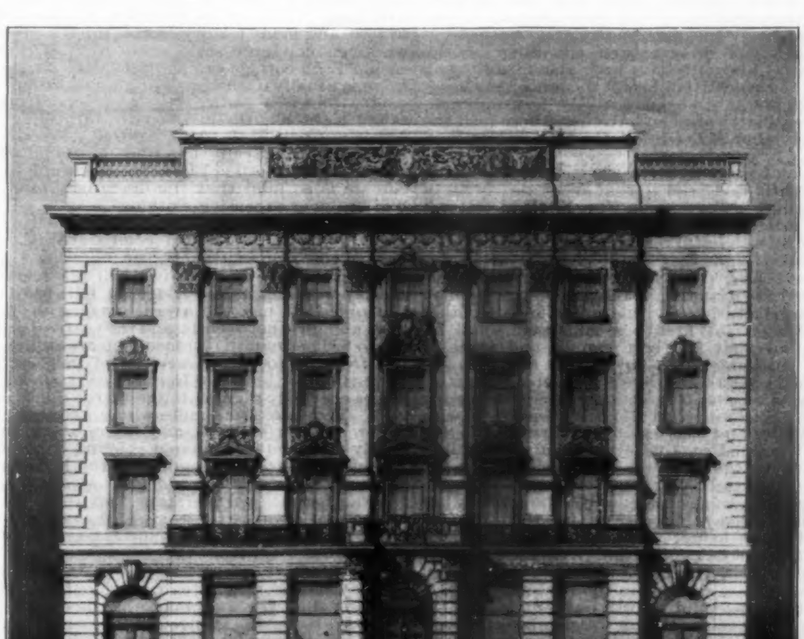


PLAN OF FIRST FLOOR.

and duly transmitted to the trustees. The general scheme therein outlined seemed to receive the approval of several of the trustees, and your committee felt greatly encouraged by their manifest interest in the matter. The president of the Tilden Trust gave it a particularly cordial reception and, in an article which he published in Scribner's Magazine, in September, 1892, referred to co-operation with the Scientific Alliance, on some such lines as proposed by us, as one of the possible methods of accomplishing the objects of Mr. Tilden's generous bequest. But when the Tilden fund was transferred to the trustees of the New York Public Library it looked as if an end had been made of all the hopes we had built upon the negotiations with the Tilden trustees. We owe it, however, to the Hon. Andrew H. Green that the subject was subsequently taken up, in a much modified form, by the trustees of the Public Library, who appointed a committee to consider the matter. But that committee has never invited your building committee to a formal conference, and, as far as we can learn, has made no report to the appointing body. The library trustees have, however, put upon record a resolution declaring the duties of the corporation, among which are included "alliances or affiliations with the principal scientific societies of the city and the gathering together of their libraries and collections in the main building, and the furnishing to them of facilities for meetings, and arrangements for the giving of lectures on scientific, literary and popular subjects."

On November 15, 1892, a joint meeting of the societies composing the Alliance was held in the lecture hall of the American Museum of Natural History, at which the aims of the Alliance were set forth in five carefully prepared addresses, and the project for the possession of a building was given a prominent place and fully elaborated. The proceedings of that conference were afterward printed in pamphlet form and widely distributed, and thus served to supplement the efforts of the building committee in making known to the public the purpose toward which it was working.

In December, 1892, negotiations were opened with the president of the American Museum of Natural History having in view a possible arrangement by which the societies in the Scientific Alliance might become, at least temporarily, tenants of the museum. These negotiations have been dropped and resumed at different periods, and at one time took the form of a proposal that the museum authorities should co-operate with the council of the Alliance in procuring legislation which would enable the Alliance to construct a building on the northwest corner of Manhattan Square, the architecture to be such as to harmonize with that of the museum, with the idea that whenever the museum should cover the rest of the square the Alliance building would form an integral part of the general structure or group of structures. The scheme was worked up out of deference to the opinion of many members of the Alliance who thought it most natural that the scientific societies should be affiliated with the museum for mutual helpfulness and for the creation of a great scientific center at Manhattan Square. But no encouragement was obtained from the museum authorities for this comprehensive plan and it was soon abandoned. We did, however, receive some encouragement for the idea of occupying rooms in the museum building, as



SCIENTIFIC ALLIANCE BUILDING.—FROM DESIGN OF R. W. GIBSON, ARCHITECT.

tenants at pleasure of the trustees, but when we came to discuss the details of such an arrangement so many administrative difficulties were discovered that it was deemed impracticable.

In January, 1893, the question of removing the present City Hall to Bryant Square and devoting it to the use of the Tilden trustees for library purposes was discussed, and it looked as if it might be decided affirmatively. Your committee took advantage of this situation to address a memorial to the Municipal Building Commission, which had the matter in charge, urging that, in case the City Hall was to be converted to educational purposes, the Scientific Alliance be given a permanent home in it in return for such services as it could render the public through the use of its libraries and free lecture courses. It was not necessary to pursue this project long, because public sentiment compelled the abandonment of the plan for removing the City Hall from its present site.

In June, 1895, the council was incorporated by an act of the Legislature of the State of New York, in which the objects were stated as follows: "To establish and maintain a scientific center in the city of New York, in which scientific societies can have their headquarters; to establish, accumulate, hold and administer a public library and a museum, having special reference to scientific subjects; to publish scientific works or periodicals, to give scientific instruction by lectures or otherwise and to advance by appropriate means scientific discovery and the knowledge of scientific truth among the people; and to these ends to take and hold property as aforesaid; to erect or acquire by deed, contract or otherwise, a suitable building, buildings, or part of a building, to contain such library and museum and other rooms appropriate to the purposes aforesaid, and to the advancement of the scientific objects of the various societies represented in said corporation."

Early in 1896 the committee began to realize that the several plans which had been considered for co-operation between the Alliance and other institutions were not developing into tangible shape, and they therefore turned their attention to the original idea of a building exclusively for the use of the Alliance. To this they felt encouraged by the evidences then appearing that the general financial condition of the country was beginning to improve, and by the revival of public spirit and local pride manifested by many generous gifts and other practical aids bestowed upon various benevolent and educational enterprises by the citizens of New York. Accordingly, without relinquishing the lines of effort previously pursued, the committee began a quiet study of the broader problem and invited several well known architects to make preliminary sketches of a building calculated to meet the needs of the allied societies and to come within a limit of cost for which it seemed possible that the council might raise the money.

The first design submitted was by Mr. George Martin Huss, and was intended for a building entirely given up to the uses of the societies, and consequently producing no revenue except from the occasional rental of its halls. The elevation was submitted to the council at the meeting of May 21, 1896, and was adjudged to be dignified and impressive in style, but the question immediately arose as to the advisability of providing for office and store space in addition to lecture halls and meeting rooms in the building, and it was suggested to the committee to procure an alternative design embodying these features. Accordingly, at the council meeting of February 25, 1897, the committee submitted plans made by Mr. R. W. Gibson, and they were thoroughly discussed and referred back for certain modifications. Both the architects who have made sketches have performed a great deal of gratuitous labor on our behalf and are entitled to the gratitude of the council. During the past summer Mr. Gibson has given particular attention to the development of our ideas and has patiently drawn and redrawn his designs several times. The result is that we are now able to present an elevation and plans which seem to us as nearly ideal as they can be made without knowledge of the actual spot upon which the building is to stand and the amount of money that may be devoted to its erection. It is believed that the necessary land can be procured in a desirable location for not more than $200,000, and that the building can be erected of the best materials for about $300,000.

The scheme supposes that the building will occupy four city lots, upon a corner, thus giving one hundred feet frontage on each street. This arrangement permits of ample entrances and exits as well as an abundance of side light. The first floor plan provides for two rentable offices or stores from which it may be possible to obtain sufficient income, in connection with rentals of lecture halls, etc., to pay the operating expenses of the building, thus entirely relieving the societies from any charges for their rooms, as, under our charter, the property will be exempt from taxation. The large auditorium is calculated to seat one thousand persons, and is approached by ample hallways directly from the street. The main feature of the second floor is a large parlor or club room, extending across the whole front of the building, which is intended to be a place of general rendezvous and social intercourse for the members of the societies. On this floor, however, there is also an assembly room which is to be for the common use of the societies for meetings that may be larger than can be accommodated in their separate apartments. When not so used, it is to be available for public rental. On the second, third and fourth floors twelve society rooms and four laboratories are provided. Eight of the former will be assigned to the societies now included in the Alliance and four will be reserved for societies that may be admitted hereafter. In the meantime they may be rented.

The fifth floor is lighted largely from the roof and is devoted exclusively to the library and reading rooms, with double-tiered stacks for about 200,000 books. It is not necessary to go into a minute description of these plans, as the drawings submitted herewith exhibit plainly the details, which have all been worked out with much care. We believe that every essential requirement has been met as fully as the limits of space will permit, and we are so well satisfied with the plans as a whole that we recommend that they be reproduced in suitable form for distribution to the members of the Alliance, and also that a considerable number be sent out to the public, accompanied by appropriate text, in the hope that interest may be awakened in the enterprise we have in hand, and with faith that the paper may come under the notice of some generous citizen who will be induced to at least inaugurate a movement for the happy realization of what is now but an earnest desire on our part.

The general financial improvement of which we have spoken not only has continued, but has gathered force during the past year, so that now many good judges of business matters confidently look forward to a period of substantial prosperity. If their anticipations are well founded, we may have before us the great opportunity for which we have long waited, to place before the public spirited citizens of New York, with success, an appeal for the establishment of science upon a firm and enduring basis in this enlarged and aspiring metropolis. We feel confident that the time has come to put forth an earnest effort in this direction and trust that the council will confirm our purpose and reinforce our endeavor by all the means that can be properly invoked for the cause.

Respectfully submitted, for the committee,

C. F. COX, Chairman.

COUNCIL OF THE SCIENTIFIC ALLIANCE OF NEW YORK, 1897-1898.

From the New York Academy of Sciences.—J. J. Stevenson, President. Charles F. Cox, Henry F. Osborn.

From the Torrey Botanical Club.—Addison Brown, President. N. L. Britton, Henry H. Rusby.

From the New York Microscopical Society.—Frank D. Skeel, President. Charles S. Shultz, J. L. Zabriskie.

From the Linnæan Society of New York.—Frank M. Chapman, President. J. A. Allen, L. S. Foster.

From the American Mathematical Society.—Simon Newcomb, President. Thomas S. Fiske, J. H. Van Amringe.

From the New York Mineralogical Club.—George F. Kunz, President. D. S. Martin, W. D. Schoonmaker.

From the New York Section of the American Chemical Society.—William McMurtrie, Chairman. Marston T. Bogart, C. F. McKenna.

From the New York Entomological Society.—Charles Palm, President. William Beutenmuller, E. G. Love.

Officers of the Council, 1897-98.—President: Charles F. Cox. Treasurer: W. D. Schoonmaker. Secretary: N. L. Britton.

COTTON MILLS IN THE SOUTH.

By GEORGE ETHELBERT WALSH.

ONE of the most remarkable industrial changes of the last quarter century is the shifting of the cotton mills from New England to the Piedmont or foothill section of the South, embracing parts of the following States: Virginia, North and South Carolina, Georgia, Alabama, Mississippi, Tennessee and Kentucky. This change in a great manufacturing industry has not been sudden or unexpected, but it has been gradually coming about for nearly twenty years, and its ultimate effect upon the trade relations of the North and South can only be conjectured at this time. That it has and will continue to benefit the South at the expense of the North can hardly be doubted, unless the New England mills, by virtue of certain inherent advantages, maintain their supremacy through superior machinery and skilled labor or by the adoption of other lines of manufacturing.

There are not wanting those who still believe that the New England cotton mills will eventually adjust themselves to the new order of things and hold their own against Southern competition. But without entering into the merits of either side of the controversy, it is interesting to note the wonderful, almost miraculous, growth of cotton manufacturing in the South.

Most of the new cotton mills of the South are located east of the Mississippi in the States named above. The Piedmont section is apparently adapted by nature to textile manufacturing. It is located in the heart of the great cotton belt, where the raw product for the mills can be obtained direct from the growers and at little expense for carting. Numerous streams of water furnish all the power required, while boat and railroad lines make transportation to the trade centers of the world comparatively cheap and adequate. Not less important than any of these natural advantages is the labor question. The mills have been able to call upon the surrounding population for all the labor they need, and, although not as skilled as the New England operatives, the Southern workmen have heretofore held the worth of their labor at much less than their Northern competitors.

At the close of the war there was scarcely a cotton mill in the South, and prior to that event nearly all of the cotton spinning was done in New England. It was through the gradual awakening of the South to an appreciation of its wonderful resources and the new order of industrial conditions that textile manufacturing was started and encouraged in the Piedmont section. Some one recognized the natural advantages of the country for cotton manufacturing, and one mill followed another in rapid succession. At first these mills were small, insignificant affairs, but Northern capital, and much of it from New England, sought investment in the South, and mammoth textile mills were constructed. Thus up to 1890, about a quarter of a century after the closing of the war, the South had 255 mills equipped with 1,700,000 spindles and 39,000 looms. Marvelous as this development seemed at that time when the United States census was taken, it was to be eclipsed by the following seven or eight years.

At the beginning of the present year the mills in the South had increased in number to 483, with 4,100,000 spindles and 103,000 looms. Last year these mills consumed over 1,000,000 bales of cotton. With the exception of three small mills in Arkansas and nine in Texas, all of these textile mills are situated in the Piedmont section and east of the Mississippi. North Carolina leads all of the other States of this region in the number of its cotton mills, having within its territory on January 1, 1898, 182 mills, with an average of 5,000 to 15,000 spindles in each. The center of the industry in this State is near the cities of Raleigh, Charlotte and Greensboro. Gaston County leads all other counties in the South in the number of its mills, and it is said that Gastonia, though a small town, has probably more factories within its immediate neighborhood than any town or city in the world. Over $2,000,000 capital are invested in the cotton mills of Gaston County, divided among 21 mills, with an aggregate of 97,000 spindles. As one may judge from these figures, many of the mills are small, the extremes ranging from 2,000 to 12,000 spindles. The water power of this section is so perfect that it is said on good authority that fully 100 mills could be operated successfully.

South Carolina enjoys the distinction of owning the largest cotton mill in the South, and this mammoth concern is well worth a visit to Greenville, where it is located. It is owned by the Pelzer Manufacturing Company, and it operates 107,000 spindles and 3,200 looms. In the vicinity of Greenville the group of mills represents in the aggregate over 400,000 spindles. South Carolina has altogether 81 mills, but this represents more looms and spindles than those contained in North Carolina's 182 mills. Owing to their size, they represent 1,272,000 spindles and 37,000 looms.

Georgia comes third in the line of cotton manufacturing in the South. Most of her mills are scattered throughout the State, and, as a rule, they are large mills. Augusta promises to be a great center for the mills in the near future, as it has the natural advantage of excellent water power and a location right in the heart of the cotton-growing district. The mills in Alabama, Mississippi, Tennessee, Kentucky and Virginia are scattered over a wide area of territory, and not grouped together, as in the Carolinas. They represent both large and small factories.

The Southern cotton mills are generally equipped with all modern labor-saving devices, but they differ in construction from those of New England. They are rarely more than three or four stories high and some are only two stories, because land is cheap and easily obtained on choice sites. Clay for making bricks and trees for lumber are so abundant throughout the cotton district that both can be obtained within a few hours' haul of any mill site. The question of constructing a mill in the South is, consequently, an important factor in determining the matter of profit and loss. The cost of building the mill, independent of machinery and general equipments, is thus reduced to the lowest minimum.

Where water power is not employed for running the mills—and quite a number are run by steam—the fuel problem is of vital consideration. Wood is used extensively in some of the mills for generating steam, and as this can be obtained as low as $1.50 per cord, it is estimated that the cost of steam averages about $10 per year per horse power. Coal is likewise cheap, and it is supplied to many of the mills in favorable localities at $2 per ton. Then the nearness of the mills to the cotton fields is supposed to save the owners from 7 to 10 per cent., an item that works almost a revolution in the cotton manufacturing industry. To offset this natural advantage of the South over the North, the New England mills have to resort to methods of economy never before attempted by them. Freight rates from the Southern mills to the great distributing centers of textile goods are made so low that it costs no more to put them in the leading markets of the world than it does from New England mills. Railroad sidings run direct to most of the mills, and the finished goods are sent direct to the sea coast or to their inland destination.

The lower wages paid in the South and the longer hours that employes work give the new mills an advantage over the New England factories that is variously estimated from 10 to 25 per cent. The operators in the Southern factories are drawn from both the white and colored population. The former predominate, and, with but few exceptions, do most of the skilled work in the mills. Experiments made with negroes in positions where great skill is required show that they are quite capable of performing the work, but race prejudice makes it inexpedient to place white and black operatives at looms and spindles in the same mill. There seems to be no objection to the negro doing certain work about the mills, such as making fires, driving carts and carting the raw and finished goods to and from the factory, but his presence is resented in many mills in the operatives' rooms.

Wages are lower than in New England, and the skilled workmen do not grumble, because living is so much cheaper. Most of their homes are small wooden structures, which can be erected in the South from $200 to $500, and many factory owners build houses for their workmen on a large scale at an average cost of $300 each. Each cottage can accommodate six people, and there is usually a small plot of ground around it for a garden. In this garden vegetables and fruits can be raised eight months in the year, furnishing quite an important part of the food required. Wood for fuel or heating is practically free and in unlimited supply. The clothing question is also an important item. The climate is so mild that the operatives rarely have to buy heavy or expensive clothing.

These are the natural favorable conditions which make living in the South comparatively cheap. In view of these circumstances, the following wages which are paid the factory operatives will not seem so small as they would in a New England mill town. Among the mills that pay the average wages one finds that boys and girls between 14 and 20 years of age receive $10 to $20 per month; women who are skilled at weaving, from $6 to $9 per week; and men employed in various higher branches from $8 to $12 per week. These wages are fairly representative of the Southern cotton mill. There are some mills whose average pay roll is as low as $3.50 per week, and others which pay considerably more, but the average is found between the two extremes. Were the conditions the same as in New England, these wages would not long be tolerated by the Southern skilled operators; but they are not, and one cannot compare the wages of the two sections without considering all the circumstances of living mentioned above.

Forty cars of meat were rushed out of Chicago last week for the East in a remarkably short time, says The Railway Review. At five o'clock one Saturday afternoon the Hammond Packing Company was asked to supply the United States government with 10,000 cases of canned meat; a reply was at once given closing the contract, and in ten minutes engines were pushing long lines of cars into the yards of the packing company. By eight o'clock two full trains stood in the yard, and by nine-thirty they were filled and the immense order was started eastward.

ELECTRICAL NOTES.

A story is going the rounds of the newspapers that, in a Western reformatory for girls, a chair is in use for punishing the juvenile offenders by seating them upon it and then "spanking" them by electricity. We are glad to be able to state that the story is entirely untrue, and is denied by the manager of the institution.

A company to be known as the St. Petersburg Company for the Transmission of Power from Waterfalls has recently been organized at St. Petersburg, Russia, to put down plants for the utilization of the Narowa, Imatra and Wuozen Waterfalls in the generation of electrical power, and to transmit to and distribute the same in St. Petersburg and surrounding districts for electric lighting and power purposes. The capital of the company is said to be $2,000,000.

The last horse tramcar has been taken off the streets of Budapest. All the tramway lines have been converted now into electric lines for a length of seventy miles; while the Budapest Underground Railway also has electric traction for a further distance of fifty-three miles. This is regarded as a bit of very creditable enterprise for a city of only 600,000 inhabitants, but the Hungarians are not yet satisfied, and plans for an extensive system of electric elevated and underground railways have just been made public and have been received with general approval, as is everything else that is designed to embellish or improve the city. It is claimed for Budapest that it is the only large city in Europe in which the horse has been banished from the streets, so far as the tramways are concerned.

Good progress is being made, says The Financial News, with the extension of the transcontinental telegraph to Tete from Umtali. A line already exists from Salisbury to Tete, and messages have been regularly sent by it; but it passes through country where the natives give a good deal of trouble, and it is not intended to repair it. Salisbury and Umtali have for long been connected by wire, and it is now intended to make the Salisbury-Umtali section a link in the transcontinental route, the wire being taken northward from Umtali to Tete. From Tete the line will be taken across the Zambesi, and it is anticipated that it will reach Karonga, on the northwest of Lake Nyassa, about April next, which means that the north end of the lake will be in direct telegraphic communication with London. From Nyassa an excellent road stretches to the southern shore of Lake Tanganyika. Connection with Tete will be established about the end of January, if all goes well.

Work on the subway of the Philadelphia and Reading Railway, in Philadelphia, is progressing favorably, and those in charge expect to have it in operation by the spring of 1899, says Engineering News. Material changes in plans have been made in the line of economy. At Sixteenth Street, where a car lift, costing $200,000, was originally proposed, the company has bought the block occupied by the Whitney Car Wheel Works. It will tear down the buildings and substitute inclined tracks for the lift. Instead of ventilating the tunnel portion by a power house and fans, costing $323,000, ventilating shafts will be built into the tunnel. Between Twenty-second and Twenty-fifth Streets, a strip of land 40 feet wide has been taken from the south side. The owners of this property claimed $791,-435 for damages; but the jury of award appointed by the court has awarded $436,723, and it is not expected that the total will exceed half a million. The original estimate of cost set aside $1,000,000 as the probable amount to be paid for property taken.

The use of electrolytic methods for refining copper has been so successful and general that attempts have been made to obtain zinc from refractory ores by simple processes. While there is an extensive commercial demand for pure copper, the use of pure zinc is somewhat limited, and the low value of the metal itself makes possible its extraction from the ordinary ores. Now, however, it is proposed to apply new processes to the treatment of the Broken Hill ore of New South Wales, which contains 30 per cent. each of lead and zinc as sulphides, together with 25 to 30 ounces of silver to the ton. The process consists of first crushing and roasting the ore, after which it is leached with ferric chloride or sulphate. The zinc passes into solution while the iron is precipitated as ferric hydrate. The lead and silver remains in the vats, and the zinc solution, now freed of the iron, passes to the cathode chambers of the depositing vats, and one-third of the zinc is deposited as a metal. In the first series of anode chambers of the vats are iron anodes, forming ferrous sulphate, while in the remainder carbon electrodes are used, so that it is converted to ferric sulphate. Passing from the electrolytic vats, the material goes to the leaching vats, and the process is continued. A plant has been operated upon this plan for several months, but its success has not as yet been assured.

A very simple and effective way of cleaning rusted iron articles, no matter how badly they are rusted, consists, according to Carl Hering (Electrical World), in attaching a piece of ordinary zinc to the articles and then letting them lie in water to which a little sulphuric acid is added. They should be left immersed for several days, or a week, until the rust has entirely disappeared, the time depending on how deeply they were rusted. If there is much rust, a little sulphuric acid should be added occasionally. The essential part of the process is that the zinc must be in good electrical contact with the iron. A good way is to twist an iron wire tightly around the object and connect this with the zinc, for which a remnant of a battery zinc is suitable, as it has a binding post. Besides the simplicity of this process, it has the great advantage that the iron itself is not attacked in the least as long as the zinc is in good electrical contact with it. When there is only a little rust a galvanized iron wire wrapped around the object will take the place of the zinc, provided the acid is not too strong. The articles will come out a dark gray or black color and should then be washed thoroughly and oiled. The method is specially applicable to objects with sharp corners or edges, or to files and other articles on which buffing wheels ought not to be used. The rusted iron and the zinc make a short-circuited battery, the action of which reduces the rust back to iron, this action continuing as long as any rust is left.

MISCELLANEOUS NOTES.

Coral is now applied in mosaic or tortoise shell and other materials for the ornamentation of glove and jewel boxes and of musical instruments at the Royal School of Coral Work and Decorative Art, at Torre del Greco, near Naples. It is also used to ornament picture frames and artistic furniture.

The value of imports into Madagascar in 1896 was as follows:

From England and colonies	$1,150,000
" France	656,000
" United States....	497,000
" Germany....................	138,000

More than one-half of the imports are woven goods, and in this class the figures are as follows:

From England and her colonies.....	$755,000
" United States.	430,000
" France.......	110,000
" Germany	63,000

—La Science en famille.

Extensive experiments have been conducted at Freiburg for the purpose of discovering the best method of preserving eggs, twenty eggs having been prepared by each of twenty different methods and kept for a period of eight months prior to examination. Fresh eggs only were used, the test of freshness being inability to float in a solution of 120 gm. of common salt in 1 liter of water. Of the twenty methods of preservation, only three yielded universally satisfactory results. Those three depended upon the use of waterglass, lime water and vaseline respectively. A solution of waterglass was found to be best of all, as lime water tends to communicate a disagreeable odor and taste to the eggs, while coating them with vaseline is too tedious an operation.—Jour. Soc. Arts.

In Sweden and Denmark, so says Laiterie (France), has been created a new industry that deserves notice. It consists in collecting at a central station the milk from farms within a given radius, pasteurizing it at about 75° Cent. [167° Fahr.], and then freezing it at the temperature of − 10° [+14° Fahr.]. The blocks of frozen milk are placed in stout wooden casks holding about double the volume of the blocks, and the extra space is filled with sterilized milk, after which the casks are hermetically sealed. As they are perfectly full and are kept cool by the block of frozen milk, which melts very slowly, the shocks of transportation are powerless to churn the milk into butter, and thus it may be preserved at least twenty days, so that the Danes and Swedes are now sending successfully to their neighbors and even to England whole cargoes of milk. We shall soon see, doubtless, Norwegian vessels unloading casks of milk in our ports.

The fountains of Paris are among the most interesting features of the city, and the authorities are careful to increase their attractiveness whenever an opportunity arises. An experiment has been tried by which the waters will become luminous. It was not contemplated to have the variety of colors which are displayed from time to time by fountains in the grounds of international exhibitions, and which are manipulated by the aid of apparatus placed at a height. In Paris a sort of golden yellow will alone be employed; but the waters will assume the appearance of cascades of diamonds and topazes. According to the architect, the effect will be attained by means of electric lights and colored glasses placed around the basin in such a way that the beauty of the fountain will not be diminished when seen by daylight. The fountains which were selected for trials were those in the Place Théâtre Français and the Place de la Concorde, and up to the present the anticipations of the municipal engineers are satisfactorily realized.

The coming Paris Exposition will be rich in panoramas and dioramas. The veteran artist Poilpot will give the history of exhibitions in a series of brilliant views of the most famous enterprises of this stamp, ranging from the first French National Exhibition of 1798 to the World's Fair of Chicago in 1893. The work will illustrate the changes in costume, locomotion, illumination, architecture and other branches of human activity during the century. Another composition by the same artist will revive the glories of Jena, as a sort of set-off to the too persistent Teutonic glorification of Sedan. Other artists will rival this painting by exhibiting compositions based on nearly all the French victories to be found on the Arc de Triomphe. A "Soirée at the Tuileries" will group all the celebrities of the epoch of the First Napoleon. M. Louis Dumoulin, the marine painter, is hard at work on his series of canvases illustrating "A Tour of the World in Eighty Minutes." Against the background real figures will be introduced engaged in national dances or national sports.

The Moniteur Vinicole has recently issued a statement showing the wine production of the various countries of the world in 1897. The following figures show the yield in each country for that year and the corresponding figures for 1896:

	Gallons. 1897.	Gallons. 1896.
France	711,722,000	982,432,000
Algeria	96,090,000	89,100,000
Tunis...........................	1,980,000	2,094,000
Italy..........................	571,087,000	474,606,000
Spain..........................	415,800,000	392,262,000
Portugal.......................	55,000,000	72,160,000
Azores, Canary and Madeira...	5,500,000	7,040,000
Austria........................	39,600,000	55,000,000
Hungary	26,400,000	25,300,000
Germany........................	46,200,000	68,420,000
Russia	55,000,000	63,800,000
Switzerland	27,500,000	33,000,000
Turkey and Cyprus..............	39,600,000	67,100,000
Greece.........................	26,400,000	47,300,000
Bulgaria	23,980,000	29,920,000
Servia.........................	20,240,000	24,200,000
Roumania.......................	70,400,000	165,000,000
United States	25,234,000	14,960,000
Mexico.........................	1,320,000	1,546,000
Argentine Republic.............	31,680,000	34,980,000
Chile..........................	61,600,000	37,460,000
Brazil.........................	8,580,000	10,450,000
Cape of Good Hope..............	4,290,000	1,980,000
Persia.........................	550,000	704,000
Australia	2,002,000	3,960,000

SELECTED FORMULÆ.

Paste for Cleaning Show Windows.—Castile soap, 2 parts; water, 3 parts. Dissolve the soap in the water and add: Prepared chalk, 4 parts; Vienna chalk, 3 parts; Tripoli, fine, 2 parts. Stir into a homogeneous mass and put in moulds to set.

Tragacanth Mucilage, for Paper.—

(a)	Pulverized tragacanth............	1 ounce.
	Glycerin..........................	4 fl. "
(b)	Boiling water.....................	16 fl. "

Macerate the tragacanth with the glycerin in a glass mortar, then stir the paste into the boiling water. This makes a very thick mucilage; 32 fluid ounces of boiling water gives a medium, and 64 fluid ounces a thin paste. Tragacanth paste works very smooth, but it is not very adhesive.

Household Mucilage, for Paper, etc.—

(a)	Pulverized gum arabic..........	3 ounces.
	White sugar.....................	1 "
	Boiling water	5 fl. "
(b)	White wine vinegar	1 fl. "
	(or ¼ ounce acetic acid with ¾ ounce water.)	

Mix (a) with (b). The acid is added to the gum in order to make it take hold of metal.

Dextrine Mucilage, for Paper, etc.—

Yellow dextrine	4 ounces.
Soft or distilled water....	6 fl. "

Dissolve cold, as heat destroys the adhesive properties of dextrine. If a more fluid gum is desired, use 8 fluid ounces of water.

Dextro-Acacia Mucilage, for Paper, Parchment, etc.—

(a)	Yellow dextrine	4 ounces.
	Cold water........................	8 fl. "
(b)	Pulverized gum arabic	4 "
	Boiling water.....................	8 fl. "
(c)	Glycerin.........	2 fl. "
	Oil of cinnamon	4 drops.

Dissolve each separately, then mix. This is a good article and easy to prepare. It does not keep as well, however, as borax mucilage, which is unalterable.

White Smelling Salt.—Mix in a capacious porcelain mortar 2·2 pounds of ammonium carbonate with 1·1 pound of ammonia, cover the mortar and let it stand quietly. In the course of a few days the contents have been converted into normal carbonate of ammonium. The latter is reduced to a coarse powder and perfumed with—

Bergamot oil........	0·56 drachm.
Lavender oil	0·9 "
Nutmeg oil.......	0·28 "
Clove oil	0·28 "
Rose oil...	0·28 "
Cinnamon oil	2·82 "

The incorporation of the volatile oils is effected by first triturating about one-tenth of the salt with the oils and then gradually incorporating with this perfumed mass the rest of the salt. In this manner a uniform distribution of the odor is effected.

"Champagnized" Milk.—"M. Cassius has patented a process," says Cosmos, "for the sterilization of all fermentable liquids by means of compressed oxygen. To sterilize liquids such as wine, milk, beer, liquors, etc., it suffices to subject these liquids, in a close vessel, to a current of gaseous oxygen, proportioning the volume of gas to the quality and quantity of liquid to be sterilized. All liquids thus treated can be preserved indefinitely. The inventor applies his process to milk, which, according to him, can thus be kept fresh indefinitely. If the results correspond with the inventor's hopes the discovery is a valuable one, for hitherto the preservation of pure milk is a problem that has been solved very imperfectly. In any case the process enables us to prepare a very healthful and agreeable drink, 'champagnized' milk. The milk to be champagnized must first be skimmed to prevent the formation of clots during the process. Then the necessary sweetening is added, and the desired flavor, and the whole is placed in a closed vessel. The sterilization is then accomplished by means of a current of oxygen gas, and then the champagnization by means of the introduction into the vessel of the necessary amount of carbonic acid gas. The drink thus prepared is extremely refreshing, healthful and of an exquisite flavor, and adds to these advantages that of keeping fresh indefinitely."

Coloring for Colognes and Toilet Waters.—Chlorophyl may be employed for coloring alcoholic solutions of a green tint. This substance may be purchased or it may be prepared as follows: Digest leaves of grass, nettles, spinach or other green herb in warm water until soft; pour off the water and crush the herb to a pulp. Boil the pulp for a short time with a half per cent. solution of caustic soda, and afterward precipitate the chlorophyl by means of dilute hydrochloric acid; wash the precipitate thoroughly with water, press and dry it, and use as much for the solution as may be necessary. Or a tincture made from grass as follows may be employed:

Lawn grass, cut fine.......	2 ounces.
Alcohol............................	16 "

Put the grass in a wide mouth bottle, and pour the alcohol upon it. After standing a few days, agitating occasionally, pour off the liquid. The tincture can be used with both alcoholic and aqueous preparations.

Among the anilines, spirit soluble malachite green has been recommended.

A purple or violet tint may be produced by using tincture of litmus or ammoniated cochineal coloring. The former is made as follows:

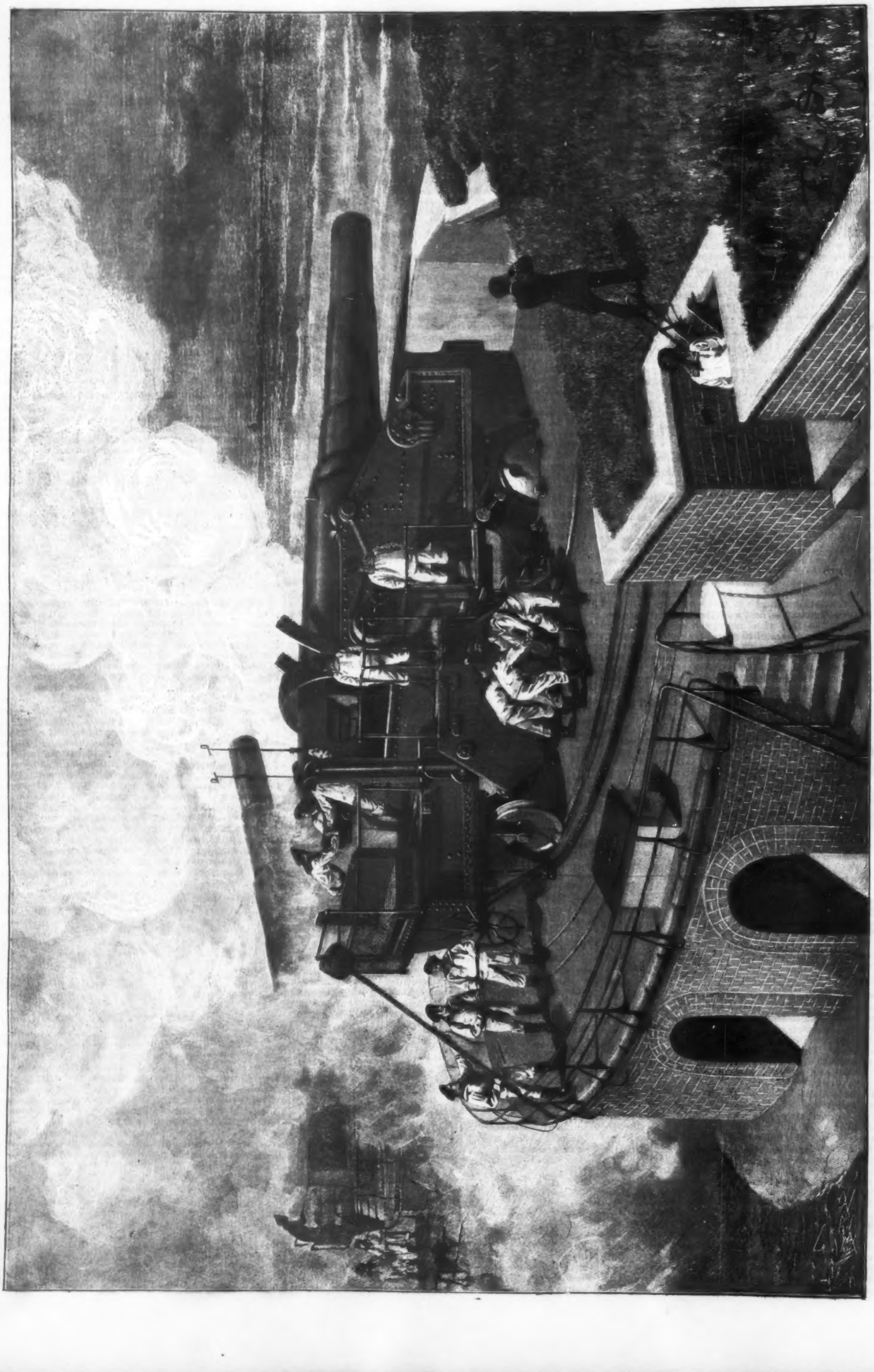
Litmus.	3½ ounces.
Boiling water....	16 "
Alcohol..........................	3 "

Pour the water upon the litmus, stir well, allow to stand for about an hour, stirring occasionally, filter, and to the filtrate add the alcohol.

The aniline colors "Paris violet" or methyl violet B may be similarly employed. The amount necessary to produce a desired tint must be worked out by experiment. Yellow tints may best be imparted by the use of tincture of turmeric or saffron, fustic, quercitron, etc.—Pharmaceutical Era.

THE GREAT SHORE BATTERY AT CUXHAVEN.

THE task of defending our shores during war would devolve upon our navy and upon our coast defenses. Our sea coasts would be primarily best protected by our fleet acting on the offensive. The fleet would be aided by forts erected at those points which would be liable to an attack. These points are especially, or more correctly speaking exclusively, situated at the mouths of the rivers, since the remaining coast is amply protected by sandbanks which would threaten an enemy with shipwreck. It is by no means beyond the bounds of impossibility for a hostile fleet to enter the mouth of the Elbe. If all the buoys which mark the navigable channel were removed, it would still be possible for a daring admiral to reach Hamburg; leaving out of consideration the fact that explanatory charts might easily fall into the enemy's hands, a hostile squadron could sail up the river under the guidance of sea captains of foreign merchant vessels, who, making regular voyages up and down the river, are well acquainted with all dangerous portions. For this reason it is that at Cuxhaven, near the mouth and at



THE GREAT SHORE BATTERY AT CUXHAVEN.

the narrowest portion of the river, a number of forts of such strength have been erected and equipped with such powerful ordnance that it would be an impossibility for a hostile squadron to proceed up the river. A glance at the illustration which accompanies this article shows what monstrous guns defend the channel at this point. Into the breech of the gun pictured in the foreground a projectile is being introduced. The gun shown in our engraving is represented with such accuracy that the necessity of a technical description but little interesting to the laity is obviated. A conception of the colossal dimensions of this weapon may be obtained by comparing the almost dwarflike dimensions of the men standing beside the gun with the giant proportions of the piece itself. A single shot would place a vessel out of action, and only an exceedingly rash naval commander would dare to face the murderous fire from this battery.—Illustrirte Zeitung.

A FRENCH RAILWAY ACCIDENT.

DURING the night of March 6, a collision, preceded by a derailment, occurred on the railway between Paris and Marseilles, but, fortunately, no lives were lost as the result of it. The accident happened to lightning express No. 20, which started from Marseilles at 7 hours 55 minutes, was due at Lyon-Perrache at 1 hour 20 minutes, and was following express train No. 10 at 20 minutes' interval. It was exactly 1 hour 45 minutes at the time of the accident, and the train was running at a speed of 48 miles an hour between the Estressin and Chasse stations, at 15 miles from Lyons.

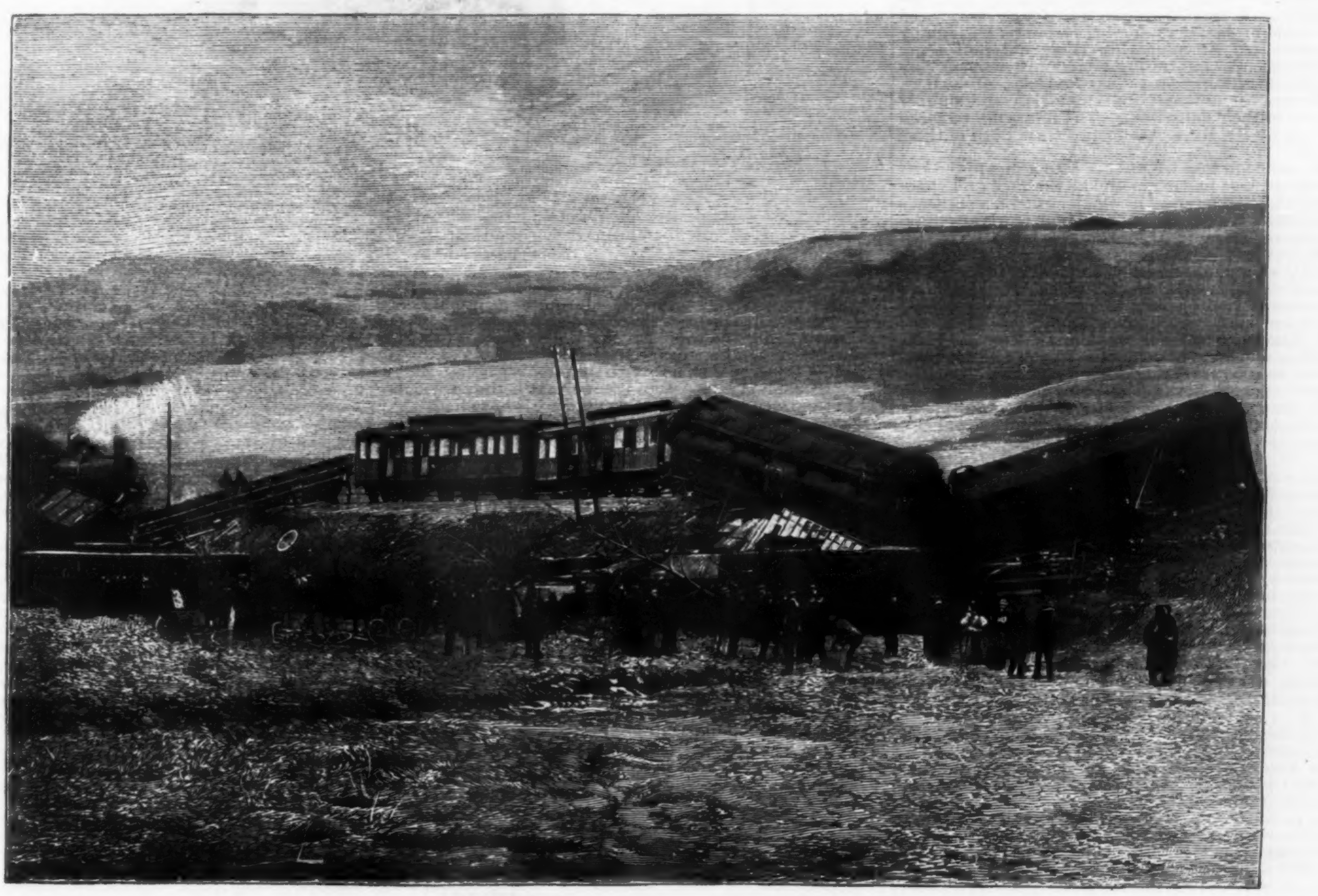
The locomotive suddenly left the rails and, carrying along the tender, rolled down the embankment, from a height of 16 feet, into a field called Roche-Piquet. The coupling chains broke, and this prevented the fall of the rest of the train, but, obedient to the impulsion given, the latter jumped from the up to the down track, ran a distance of 150 feet, and then stopped.

Mindful of the recent catastrophe of Clonas, the passengers, most of them at least, had the presence of mind to jump to the ground; it was well that they did so, since scarcely had they left their cars when a formidable detonation was heard, the train oscillated and the cars stood upon end one against another, and then fell back in fragments. The express had just been run into by a freight train coming from Chasse, and consequently running upon the up track.

The engineman and fireman, who had not left their post, were found at the bottom of the embankment. The fireman lay stunned at the foot of a cherry tree and the engineman remained unconscious upon the locomotive.

M. Platel, the company's new chief inspector, at once began an investigation in conjunction with M. Bourgeon, procureur of the republic. The discovery that the rails were intact and the bolts withdrawn led to the conclusion that the derailment was due to maliciousness.—Le Monde Illustré.

For cleaning prescription balances and weights, the Sudd. Ap. Ztg. recommends the following, already partly known, method: Equal parts of oleic acid, water of ammonia, and absolute alcohol are mixed, and filtered after settling. The articles to be cleaned are rubbed with the mixture by means of a cloth and polished with a little powdered tripoli.—Pharmaceutical Era.



ACCIDENT ON THE PARIS-LYONS-MEDITERRANEAN RAILWAY.

RECENT WORK IN THE PRINCETON PSYCHOLOGICAL LABORATORY.*

By Prof. J. MARK BALDWIN.

IN recent years the growth of the method of experimenting with bodies in laboratories, in the different sciences, has served to raise the question whether the mind may not be experimented with also. This question has been solved in so far that psychologists produce artificial changes in the stimulations to the senses, and in the arrangements of the objects and conditions existing about a person, and so secure changes also in his mental states. On the one hand Physiological Psychology illustrates this general way of proceeding, for in such studies, changes in the physiological processes, as in the breathing, are considered as causing changes in the mind. In Experimental Psychology, however, as distinguished from Physiological Psychology, we agree to take only those influences which are outside the body, such as light, sound, temperature, etc., keeping the subject as normal as possible both in his mind and also in his body.

A great many laboratories have now been established in connection with the universities, especially in Germany and the United States. They differ very much from one another, but their common purpose is so to experiment upon the mind, through changes in the stimulations to which the individual is subjected, that tests may be made of his sensations, his ability to remember, the exactness and kind of movements, etc.

The working of these laboratories and the sort of research work done in them may be best illustrated, perhaps, by a description of some of the results, apparatus, methods, etc., employed in my own laboratory during the past year. The end in view will, I trust, be considered sufficient justification for the degree of personal reference which this occasions; since greater concreteness and reality attach to definite descriptions such as this. The other laboratories, as those at Harvard and Columbia Universities, take up similar problems by similar methods. I shall, therefore, go on to describe a year's work in the Princeton laboratory.

Of the problems taken up in the laboratory, certain ones may be selected for somewhat detailed explanation, since they are from widely different spheres and illustrate different methods of procedure.

I. *Experiments on the Temperature Sense.*—For a score of years it has been suspected that we have a distinct sense, with a nerve apparatus of its own, for the feeling of different temperatures on the skin. Certain investigators found that this was probably true; it is proved by the fact that certain drugs deaden the skin to hot and cold stimulations. Another advance was made when it was found that sensations of either hot or cold may be had from regions which are insensible at the same time to the other sort of stimulation, cold or hot. Certain minute points were discovered which would feel cold when touched with a cold point, but give no feeling from a hot object; while other points would respond only with a sensation from heat, but never giving cold. It was concluded that we have two temperature senses, one for hot and the other for cold.

Taking the problem at this point, Mr. C.† wished to define more closely the relation of the two sorts of sensation to each other, and thought he could do so by a method by which he might repeat the stimulation of a series of exact spots, very minute points on the skin, over and over again, thus preserving a number of records of the results for both hot and cold over a given area. He chose an area of skin on the forearm, shaved it carefully, and proceeded to explore it with the smallest points of metal which could be drawn along the skin without pricking or tearing. These points were attached to metallic cylinders, and around the cylinders rubber bands were placed; the cylinders were then thrust in hot or cold water kept at certain regular temperatures, and lifted by the rubber bands. They were placed point down, with equal pressure, upon the points of the skin in the area chosen. In this way, points which responded only to hot, and also those responding only to cold, were found, marked with delicate ink marks in each case, until the whole area was explored and marked in different colors. This much had often been done before. It remained to devise a way of keeping these records, so that the markings might all be removed from the skin, and new explorations made over the same surface. This was necessary in order to see if the results secured were always the same. The theory that there were certain nervous endings in the skin corresponding to the little spots required that each spot should be in exactly the same place whenever the experiment was repeated.

Mr. C. made a number of so-called "transparent transfer frames." They are rectangular pieces of cardboard, with windows cut in them. The windows are covered with thin architect's paper, which is very transparent. This frame is put over the forearm in such a way that the paper in the window comes over the markings made on the arm. The markings show through very clearly, and the points are copied on the paper. Then certain boundary marks at the corners are made, both on the paper and on the arm, at exactly the same places, the frame is removed, and all the markings on the arm are erased except the boundary points. The result is that at any time the frames can be put over the arm again by matching the boundary points, and then the original temperature points in the skin will be shown by the markings on the paper window.

Proceeding to repeat the exploration of the same area in this way, Mr. C. makes records of many groupings of points for both hot and cold sensations; he then puts the frames one upon another, holds them up before a window so that they have a bright background, and is able to see at a glance how nearly the results of the different sittings correspond.

His results, put very briefly, fail to confirm the theory that the sense of temperature has an apparatus of fixed spots for heat and other fixed spots for cold. For when he puts the different markings for heat together he finds that the spots are not the same, but that those of one frame fall between those of another, and if several are put together, the points fill up a greater or smaller area. The same for cold spots. They fill a continuous area. He finds, however, as other investigators have found, that the heat areas are generally in large measure separate from the cold areas, only to a certain extent overlapping here and there, and also that there are regions of the skin where we have very little sense of either sort of temperature.

The general results will show, therefore, if they should be confirmed by other investigators, that our temperature sense is located in what might be called somewhat large blotches on the skin, and not in minute spots; while the evidence still remains good, how-

* Material used in a chapter in "The Story of the Mind," in the press of D. Appleton & Company.

† Mr. J. F. Crawford, graduate student.

ever, to show that we have two senses for temperature, one for cold and the other for hot.

II. *Reaction Time Experiments.*—Work in so-called "reaction times" constitutes one of the most important and well developed chapters in experimental psychology. In brief, the experiment involved is this: To find how long it takes a person to receive a sense impression of any kind—for example, to hear a sound signal—and to move his hand or other member in response to the impression. A simple arrangement is as follows: Sit the subject comfortably, tap a bell in such a way that the tapping also makes an electric current and starts a clock, and instruct the subject to press a button with his finger as soon as possible after he hears the bell. The pressing of the button by him breaks the current and stops the clock. The dial of the clock indicates the actual time which has elapsed between the bell (signal) and his response with his finger (reaction). The clock used for exact work is likely to be the Hipp chronoscope, which gives on its dials indications of time intervals in thousandths of a second. For the sake of keeping the conditions constant and preventing disturbance, the wires are made long, so that the clock and the experimenter may be in one room, while the bell, the punch key and the subject are in another, with the door closed. This method of getting reaction times has been in use for a number of years, especially by the astronomers, who need to know, in making their observations, how much time is taken by the observer in recording a transit or other observation. It is part of the astronomer's "personal equation."

Proceeding with this "simple reaction" experiment as a basis, the psychologists have varied the instructions to the subject so as to secure from him the different times which he takes for more complicated mental processes, such as distinguishing between two or more impressions, counting, multiplying, dividing, etc., before reacting, or they have him wait for an associated idea to come up before giving his response, with many other variations. By comparing these different times among themselves, interesting results are reached concerning the mental processes involved and also about the differences of different individuals in the simpler operations of their daily lives. The following research carried out by Mr. B.* serves to illustrate both of these assertions.

Mr. B. wished to inquire further into a fact found out by several persons by this method; the fact that there is an important difference in the length of a subject's reaction time according to the direction of his attention during the experiment. If for example Mr. X be tested, it is likely that he will prefer to attend strictly to the signal, letting his finger push the key without direct supervision from him. If this be true, and we then interfere with his way of proceeding, by telling him that he must attend to his finger, and allow the signal to take care of itself, we find that he has great difficulty in doing so, grows embarrassed, and his reaction time becomes very irregular and much longer. Yet another person, say Y, may show just the opposite state of things; he finds it easier to pay attention to his hand, and when he does so he gets shorter and also more regular times than when he attends to the signal sound.

It occurred to Mr. B. that the striking differences given by different persons in this matter of the most favorable direction of the attention might be connected with the facts brought out by the physiological psychologists in connection with speech; namely, that one person is a "visual," in speaking, using mainly sight images of words, while another is mainly a "motor," using muscular images, and yet another an "auditive," using mainly sound images. If the differences are so marked in the matter of speech, it seemed likely that they might also extend to other functions, and the so-called "type" of a person in his speech might show itself in the relative lengths of his reaction times according as he attended to one class of images or another.

Calling this the "type theory" of reaction times, and setting about testing four different persons in the laboratory, the problem was divided into two parts; first, to direct all the individuals selected to find out, by examining their mental preferences in speech, reading, writing, reading, etc., the class of images which they ordinarily depended most upon; and then to see by a series of experiments whether their reaction times to these particular classes of images were shorter than to others, and especially whether the times were shorter when attention was given to these images than when it was given to the muscles used in the reactions. The meaning of this would be that if the reaction should be shorter to these images than to the corresponding muscle images, or to the other classes of images, then the reaction time of an individual would show his mental type and be of use in testing it. This would be a very important matter if it should hold, seeing that many questions both in medicine and in education, which involve the ascertaining of the mental character of the individual person, would profit by such an exact method.

The results on all the subjects confirmed the supposition. For example, one of the subjects, Mr. C., found, from an independent examination of himself most carefully made, that he depended very largely upon his hearing in all the functions mentioned. When he thought of words, he remembered how they sounded; when he dreamed, his dreams were full of conversation and other sounds. When he wrote, he thought continually of the way the words and sentences would sound if spoken. Without knowing of this, many series of reaction experiments were made on him; the result showed a remarkable difference between the lengths of his reactions, according as he directed his attention to the sound or to his hand; a difference showing his time to be one-half shorter when he paid attention to the sound. The same was seen when he reacted to lights; the attention went preferably to the light, not to the hand; but the difference was less than in the case of sounds. So it was an unmistakable fact in his case that the results of the reaction experiments agreed with his independent decision as to his mental type.

In none of the cases did this correspondence fail, although all were not so pronounced in their type preferences as was Mr. C.

* The writer.

The second part of the research had in view the question whether reaction times taken upon speech would show the same thing; that is, whether in Mr. C.'s case, for example, it would be found that his reaction made by speaking, as soon as he heard the signal or saw the light, would be shorter if he paid attention to the signal than if he gave attention to his mouth and lips. For this purpose a mouth-key was used, which made it possible for the subject, simply by emitting a puff of breath from the lips, to break an electric current and thus stop the chronoscope as soon as possible after hearing the signal. This mouth-key is figured herewith (Fig. 1).

This experiment was carried out on all the four subjects, none of them having any knowledge of the

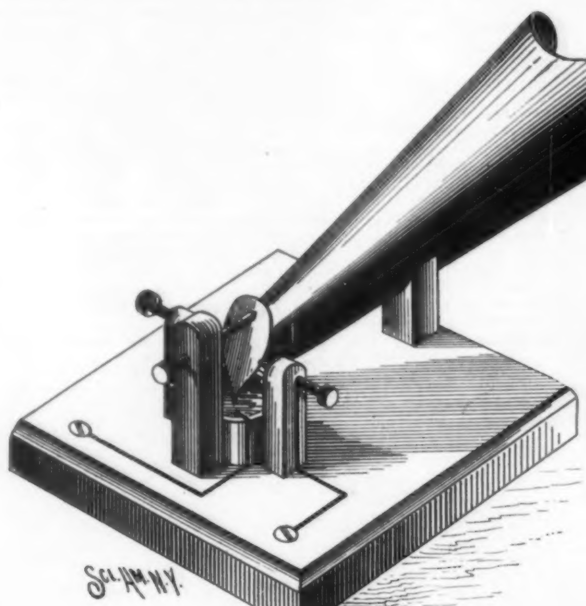


FIG. 1.

end in view, and the experimenters also not having, as yet, worked out the results of the earlier work. In all the cases, again, the results showed that, for speech, the same thing held as for the hand—namely, that the shortest reaction times were secured when the subject paid attention to the class of images for which he had a general preference. In Mr. C.'s case, for example, it was found that the time it took him to speak was much shorter when he paid strict attention to the expected sound than when he attended to his vocal organs. So for the other cases. When the individual's general preference is for muscular images, we find that the quickest time is made when attention is given to the mouth and lips. Such is the case with Mr. B.

The general results go to show, therefore—and four cases showing no exception make a general conclusion very probable—that, in the differences in reaction times, as secured by giving the attention this way or that, we have general indications of the individual's temperament, or at least of his mental preferences as set by his education. These indications agree with those found in the cases of aphasia (speech defect) known as "motor," "visual," "auditory." The early examination of children by this method would probably be of great service in determining proper courses of treatment, subjects of study, modes of discipline, tendencies to fatigue and embarrassment, and the direction of best progress in education.

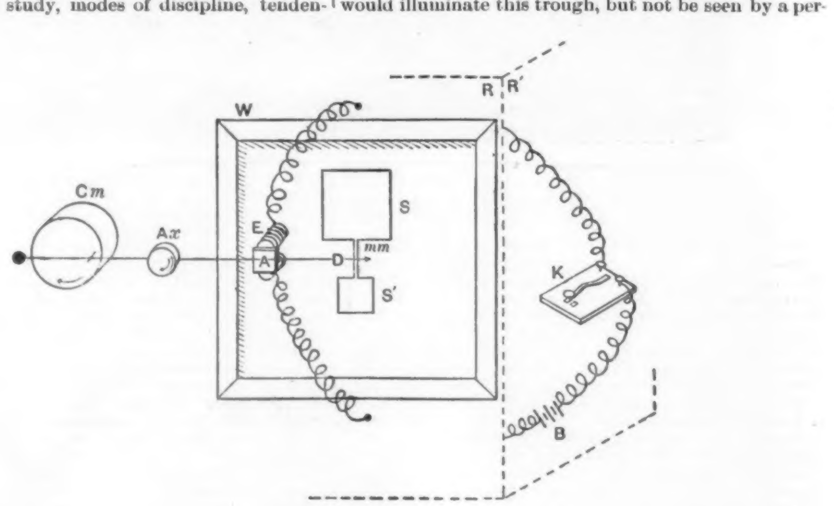


FIG. 2.

This research may be taken to illustrate the use of the reaction-time method in investigating such complex processes as attention, temperament, etc. The department which includes the various time measurements in psychology is now called "mental chronometry," the older term, "psychometry," being less used on account of its ambiguity.

III. *An Optical Illusion.*—In the sphere of vision many very interesting facts are constantly coming to light. Sight is the most complex of the senses, the most easily deranged, and, withal, the most necessary to our normal existence. The report of the following experimental study will have the greater utility, since, apart from any intrinsic novelty or importance the results may prove to have, it shows some of the general bearings of the facts of vision in relation to æsthetics, to the theory of illusions, and to the function of judgment.

Illusion of the senses is often due to the operation of mental assimilation. It illustrates the fact that at any time there is a general disposition of the mind to look upon a thing under certain forms, patterns, etc., to which it has grown accustomed; and to do this it is led sometimes to distort what it sees or hears unconsciously to itself. So it falls into errors of judgment, through the trap which is set by its own manner of working. Nowhere is the matter better illustrated than in the sphere of vision. The number of illusions of vision is remarkable. We are constantly taking shapes and forms for something slightly different from what, by measurement, we actually find them to be. And psychologists are attempting—with rather poor success so far—to find some general principles of the mechanism of vision which will account for the great variety of its illusions.

Among these principles one is known as contrast. It is hardly a principle as yet. It is rather a word used to cover all illusions which spring up when surfaces of different sizes and shades, looked at together or successively, are misjudged with reference to each other. Wishing to investigate this in a simple way, the following experiment was planned and carried out by Mr. B.

He wished to find out whether, if two detached surfaces of different sizes be gazed at together, linear distances in the field of vision (the whole scene visible at once) would be at all misjudged. To test this, he put in the window (W)* of the dark room a filling of white cardboard in which two square holes had been cut (S S′). The sides of the squares were of given and very unequal lengths. Then a slit was made joining the middle points of the sides of the squares next to each other, so that there was a narrow path or trough joining the squares between their adjacent sides. Inside the dark room he arranged a bright light so that it would illuminate this trough, but not be seen by a person seated some distance in front of the window in the next room. A needle (D) was hung on a pivot behind the cardboard, so that its point could move along the bright trough in either direction; and on the needle was put the armature (A) of an electro-magnet which, when a current passed, would be drawn instantly to the magnet (E), and so stop the needle exactly at the point which it had then reached. A clock motor (Cm) was arranged in such a way as to carry the needle back and forth regularly over the slit; and the electro-magnet was connected by wires with a punch key (K) on a table beside the subject in the next room. All being now ready, the subject, Mr. S., is told to watch the needle, which appears as a bead of light traveling along the

* This and the following letters in parentheses refer to Fig. 2.

slit, and stop it when it comes to the middle point of the line, by pressing the electric key. The experimenter, who stands behind the window in the dark room, reads off a scale (mm) marked in millimeters the exact point at which the needle stops, releases the needle by breaking the current, thus allowing it to return slowly over the line again. This gives the subject another opportunity to stop it at what he judges to be the exact middle of the line, and so on. The accompanying figure (Fig. 2) shows the entire arrangement.

A great many experiments performed in this way, with the squares set both vertically and horizontally, and with several persons, brought a striking and very uniform result. The point selected by the subject as the middle is regularly too far toward the smaller square. Not a little, indeed, but a very appreciable amount. The amount of the displacement, or roughly speaking of the illusion, increases as the larger square is made larger and the smaller one smaller; or, put in a sentence, the amount varies directly with the ratio of smaller to the larger square side.

Finding this unmistakable illusion by this method, Mr. B. thought that if it could be tested by an appeal to people generally, it would be a great gain. It occurred to him that the way to do this would be to reverse the conditions of the experiment in the following way: He prepared the figure given herewith (Fig. 3), in

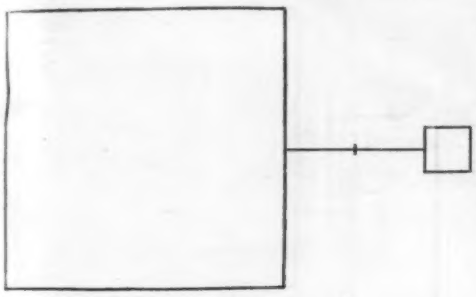


FIG. 3.

which the two squares are made of suitable relative size, a line is drawn between them, and a point on the line is plainly marked. This he had printed in a weekly journal, and asked the readers of the journal to get their friends, after merely looking at the figure (i. e., without knowing the result to be expected), to say—as the reader may now do before reading further—whether the point on the line is in the middle or not; and if not, in which direction from the true middle it lies. The results from hundreds of persons of all manner of occupations, ages, and of both sexes, agree in saying that the point lies too far toward the larger square. In reality it is in the exact middle. This is just the opposite of the result of the experiments in the laboratory, where the conditions were the reverse, i. e., to find the middle as it appears to the eye. Here, therefore, we have a complete confirmation of the illusion; and it is now fully established that in all cases in which the conditions of this experiment are realized, we make a constant mistake in estimating distances by the eye.*

For example, if a town committee wish to erect a statue to their local hero in the town square, and if on the two opposite sides of the square there are buildings of very different heights, the statue should not be put in the exact middle of the square, if it is to give the best effect from a distance. It should be placed a little toward the smaller building. A colleague of the writer found, when this was first made public, that the pictures in his house had actually been hung in such a way as to allow for this illusion. Whenever a picture was to be put between two others of considerable difference of size or between a door (large) and a window (small), it had actually been hung a little nearer to the smaller one—toward the small picture or toward the window—and not in the true middle.

It is probable that interesting applications of this illusion may be discovered in æsthetics. For wherever in drawing or painting it is wished to indicate to the observer that a point is midway between two lines of different lengths, we should find that the artist, in order to produce this effect most adequately, deviates a little from the true middle. So in architecture, the effect of a contrast of masses often depends upon the sense of bilateral balance, symmetry, or equal division, in which this visual error would naturally come into play. Indeed, it is only necessary to recall to mind that one of the principal laws of æsthetic effect in the matter of right line proportion is the relation of "one to one," as it is called, or equal division, to see the wide sphere of application of this illusion. In all such cases the mistake of judgment would have to be allowed for if masses of unequal size lie at the ends of the line which is to be divided.

IV. *The Accuracy of Memory.*—Another investigation may be cited to illustrate quite a different department. It aimed to find out something about the rate at which memory fades with the lapse of time. Messrs. S., W. and B.† began by formulating the different ways in which tests may be made on individuals to see how accurate their memories are after different periods of time. They found that three different tests might be employed, and called them "methods" of investigating memory. These are, first, the method of "reproduction." The individual is asked to reproduce, as in an oral or written examination, what he remembers of something told him a certain time before. This is the ordinary method of the schools and colleges, of civil service examinations, etc. Second, the method of "identification," which calls upon the person to identify a thing, sentence, report, etc., a second or third time, as being the same in all respects as that which he experienced the first time it appeared. Third, the method of "selection," in which we show to the person a number of things, sentences, reports, descriptions of objects, etc., and require him to select from them the ones which are exactly the same as those he has had before. These methods will be better understood from the account now to be given of the way they were carried out on a large number of students.

The first experiments were made by Messrs. S. and B. in the University of Toronto on a class of students numbering nearly 300, of whom about one-third were women. The instructors showed to the class certain squares of cardboard of suitable size, and without further instruction asked them to do one of the following three things: First, to reproduce from memory, with pencil on paper, squares of the same size as those shown after intervals of 1, 10, 20 and 40 minutes (this gives results by the method of reproduction); second, to say whether a new set of squares, which were shown to them after the same intervals, were the same in size as those which they had originally seen, smaller, or larger (illustrating the method of identification); third, they were shown a number of squares of slightly different sizes, again at the same intervals, and asked to select from them the ones which they found to be the same size as those originally seen (method of selection).

The results from all these experiments were combined with those of another series, secured from a large class of Princeton students; and the figure (Fig. 4) shows by curves what the investigators found out. The figure is given in order that the reader may understand by its explanation the "graphic method" of plotting

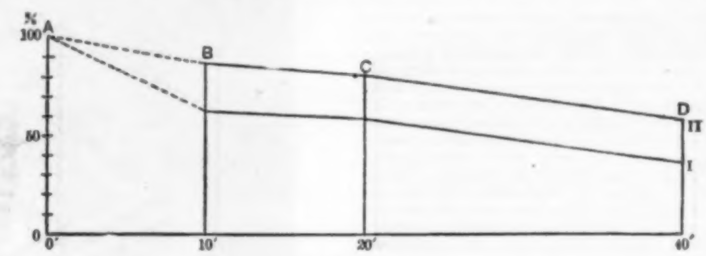


FIG. 4.

Vertical lines give percentage of correct cases. Horizontal divisions give time intervals in minutes.

statistical results, which, with various complications, is now employed in psychology as well as in the other positive sciences.

Briefly described in words it was found that the three methods agreed (the curves are parallel)* in showing that during the first 10 minutes there was a great falling off in the accuracy of memory (slant in the curves from 0 to 10); that then between 10 and 20 minutes memory remained relatively faithful (the curves are nearly level from 10 to 20), and that a rapid falling off in accuracy occurred after 20 minutes (shown by the slant in the lines from 20 to 40.)

Further, the different positions of the curves show certain things when properly understood. The curve secured by the method of reproduction (not given in the figure) shows results which are least accurate, because most variable. The reason of this is that in drawing the squares, to reproduce the one remembered, the student is influenced by the size of the paper he uses, by the varying accuracy of his control over his hand and arm (the results vary, for example, according as he uses his right or left hand), and by all sorts of associations with square objects which may at the time be in his mind. In short, this method gives for his memory of the square a chance to be fully assimilated to his current mental state, during the interval, and there is no corrective outside of him to keep him true.

That this difficulty is a real one no one who has examined students will be disposed to deny. When we ask them to reproduce what the text book or the professor's lectures have taught, we also ask them to express themselves accurately. Now the science of correct expression is a thing in which the average student has had no training. With his difficulty in remembering is connected his difficulty of expression; and with it all goes a certain embarrassment, due to responsibility, personal fear, and dread of disgrace. So the results finally obtained by this method are really very complex.

One of the curves (I), that given by the method of "selection," also shows memory to be interfered with by a certain influence. We saw in connection with the experiments reported above that, even in the most elementary arrangements of squares in the visual field, an element of contrast comes in to interfere with our judgment of size. This we find confirmed in these experiments when the method of selection is used. By this method we show a number of squares side by side, asking the individual to select the one he saw before. All the squares, being shown at once, come into contrast with one another on the background; and so his judgment of the size of the one he remembers is distorted. This, again, is a real influence in our mental lives, leading to actual illusion. An unscrupulous lawyer can gradually modify the story which his client or a witness tells by constantly adding to what is really remembered, other details so expertly contrasted with the facts, or so neatly interposed in them, that the witness gradually incorporates them in his memory and so testifies more nearly as the lawyer desires. In our daily lives another element of contrast is also very strong—that due to social opinion. We constantly modify our memories to agree more closely with the truths of social belief, paring down unconsciously the differences between our own and others' reports of things. If several witnesses of an event be allowed to compare notes from time to time, they will gradually come to tell more nearly the same story.

The other curve (II) in the figure, that secured by the method of "identification," seemed to the investigators to be the most accurate. It is not subject to the errors due to expression and to contrast, and it has the advantage of allowing the subject the right to recognize the square. It is shown to him again, with no information that it is the same, and he decides whether, from his remembrance of the earlier one, it is the same or not. The only objection to this method is that it requires a great many experiments in order to get an average result. To be reliable, an average must be secured, seeing that, for one or two or a few trials, the student may guess right without remembering the original square at all. By taking a large number of persons, such as the 300 students, this objection may be overcome.

This last point may serve to introduce a distinction which is important in all work in experimental psychology, and one which is recognized also in many other sciences—the distinction between results obtained, respectively, from one individual and from many. Very often the only way to learn truth about a single individual is to investigate a number together. In all large classes of things, especially living things, there are great individual differences, and in any particular case this personal variation may be so large that it obscures the real nature of the normal. For example, three large sons may be born to two small parents; and from this case alone it might be inferred that all small parents have large sons. Or three girls might have better memories than three boys in the same family or school, and from this it might be argued that girls are better endowed in this direction than boys. In all such cases the proper thing to do is to get a large number of cases and combine them; then the preponderance which the first cases examined may have shown, in one direction or the other, is corrected. This gives rise to what is called the statistical method; it is used in many practical matters, such as life insurance, but its application to the facts of life, mind, variation, evolution, etc., is only begun. Its neglect in psychology is one of the crying defects of much recent work. Its use in complicated problems involves a mathematical training which people generally do not possess; and its misuse, through lack of exactness of observation, or ignorance of the requirements, is worse than its neglect.

Another result came out in connection with these experiments on memory, which, apart from its practical interest, may serve to show an additional resource of experimental psychology. In making up the results of a series of experiments, it is very important to observe the way in which the different cases differ from one another. Some cases may be so nearly alike that the most extreme of them are not far from the average of them all; as we find, for example, if we measure a thousand No. 10 shot. But now suppose we mix in with the No. 10 some No. 6 and some No. 14, and then take the average size; we may now get just the same average, and we can tell that this pile is different from the other only by observing the individual measurements of the single shot and setting down the relative frequency of each particular size. Or, again, we may get another average size in either of two ways; either by taking another lot of uniform No. 14 shot, let us say, or by mixing with the No. 10 a few very large bullets. Which is actually the case would be shown only by the examination of the individual cases. This is usually done by comparing each case with the average of the whole lot, and taking the average of the differences thus secured—a quantity called the "mean variation."

In the case of the experiments with the squares, the mean variation—that is, the amount on the average by which the single cases departed from the average result of all the cases—was found to lie always in one direction. The answers of the students all tended to show that they took for the one originally shown a square which was really too large. Casting about for the reason of this, it was considered necessary to explain it by the supposition that the square remembered had in the interval become enlarged in memory. The image was larger when called upon after 10 or 20 minutes than it was before. This might be due to a purely mental process; or possibly to a sort of spreading out of the brain process in the visual center, giving the result that whenever, by the revival of the brain process, the mental image is brought back again to mind, this spreading out shows itself by an enlargement of the memory image. However it may be explained, the indications of it were unmistakable—unless, of course, some other reason can be given for the uniform direction of the average error; and it is further seen in other experiments carried out by Messrs. W. and B. and by Dr. K.* at a later date.

If this tendency to the enlargement of our memories with the lapse of time should be found to be a general law of memory, it would have interesting bearings. It would suggest, for instance, an explanation of the familiar fact that the scenes of the past seem to us, when we return to them, altogether too small. Our childhood home, the old flower garden, the height of house and trees, and even that of our hero uncle, all seem, to the returning traveler of adult life, ridiculously small. That we expect them to be larger may be simply the result that the memory images have undergone change in the direction of enlargement.

Finally an investigation by Messrs. T. and H.† may serve to show the remarkable influence of mental conditions upon certain physical processes which have always been considered purely physiological. These investigators set out to repeat certain ex-

* Some persons get the effect more strongly by using circles instead of squares; after marking the midpoint the connecting line may be erased.

† Prof. H. C. Warren, Mr. W. J. Shaw, and the writer.

* This figure shows curves for two of the methods only, "Selection" and "Identification."

* Dr. F. Kennedy, demonstrator in the laboratory (results not yet published).

† Prof. G. A. Tawney, now of Beloit College, and Prof. C. W. Hodge, now of Lafayette College.

periments of others which showed that if two points, say those of a pair of compasses, be somewhat separated and put upon the skin, two sensations of contact come from the points. But if while the experiment is being performed the points be brought constantly nearer to each other, a time arrives when the two are felt as only one, although they may be still some distance apart. The physiologists argued from this that there were minute nerve endings in the skin at least so far apart as the least distance at which the points were felt as two; and that when the points were so close together that they only touched one of these nerve endings, only one sensation was produced. Mr. T. had already found, working in Germany, that, with practice, the skin gradually became more and more able to discriminate the two points, that is, to feel the two at smaller distances; and further, that the exercise of the skin in this way on one side of the body not only made that locality more sensitive to minute differences, but had the same effect, singularly, on the corresponding place on the other side of the body. This, our experimenters inferred, could only be due to the continued suggestion in the mind of the subject that he should feel two points; the result being an actual heightening of the sensibility of the skin. When he thought that he was becoming more sensitive on one side—and really was—this sense or belief of his took effect in some way in both hemispheres of his brain, and so both sides of the body were alike affected.

This led to other experiments in Princeton in which suggestions were actually made to the subjects that they were to become more or less sensitive to distance and direction between the points on the skin, with the remarkable result that these suggestions actually took effect all over the body. This was so accurately determined that from the results of the experiments with the compasses on the skin in this case or that, pretty accurate inferences could be made as to what mental suggestions the subject was getting at the time. There was no chance for deception in the results, for the experiments were so controlled that the subject did not know until afterward of the correspondences actually reached between his states of mind and the variations of sensibility in the skin.

This slight report of the work done in one laboratory in about two sessions, involving a considerable variety of topics, may give an idea, so far as it goes, of the sort of work which experimental psychology is setting itself to do. It will be seen that there is as yet no well knit body of results on which new experiments may proceed, and no developed set of experimental arrangements, such as other positive sciences show. The procedure is, in many important matters, still a matter of the individual worker's judgment and ability. Even for the demonstrations attempted for undergraduate students, good and cheap apparatus is still lacking. For these reasons it is premature as yet to expect that this branch of the science will cut much of a figure in education. There can be no doubt, however, that it is making many interesting contributions to our knowledge of the mind, and that when it is more adequately organized and developed in its methods and apparatus, it will become the basis of discipline of a certain kind lying between that of physical science and that of the humanities, since it will have features in common with the biological and natural sciences. Its results may be expected also to lead to better results than we now have in the theory and practice of education.*

THE CENTRAL ELECTRICAL STATION OF QUAI JEMMAPES AT PARIS.

THE Parisian Compressed Air Company is one of the organizations that in 1888 obtained from the municipal council of the city authority to lay a system of conductors in the streets for the distribution of electric energy.

As we have previously stated, this company formerly distributed electric energy through the intermedium of two central stations, one of which was established at Saint Fargeau and the other on Boulevard Richard-Lenoir. These two stations in conjunction supplied, at 3,000 volts, twenty-five accumulator substations distributed throughout Paris. In 1893 the company made trial of a five-wire line supplied by the largest of the substations, that of Saint Roch, and, in 1894, decided to adopt the five-wire system of distribution everywhere. To this effect, it was decided that a central station should be constructed on Quai Jemmapes for supplying, through feeders, two large substations—that of Rue Saint Roch and that of Rue Mauconseil. From these substations start the subfeeders that supply the five-wire system of distribution at different points.

The works of Saint Fargeau and Boulevard Richard-Lenoir supply three substations in the Quartier du Marais (Rue Franche-Comté, Rue Malher and Rue de la Verrerie), and operate various rotary transformers at the Saint Roch substation. The secondary circuits of these transformers are coupled in quantity with the feeders.

CENTRAL STATION.

The new central station of Quai Jemmapes is a very large establishment installed upon the quay running along the Saint Martin canal. It consists of a large building comprising to the left a wing for the accessory services (repair shop, experiment room, accumulator room, etc.), and, to the right, a wing for the services of the administration. At right angles with the left wing is situated the boiler and engine rooms, and at right angles with the right wing there is another building for various services. The left wing forms only a part of the works, which are to be completed later on by a symmetrical wing.

We shall now pass through these three large parts of the work in succession.

Machinery Building.—The building that contains the apparatus for the production of electric energy is of two stories. The ground floor, which is 11 meters in height, is designed for the steam engines and electric machines. On the first story are installed the boilers, and in the loft above is stored the coal.

The boilers, which are of the Belleville multitubular type, have a grate surface of 5·23 square meters, and each, at a pressure of 12 kilogrammes per square centimeter, gives 3,000 kilogrammes of steam per hour. They are twenty in number and are distributed in five groups of four each. Above each group there is a water reservoir and chimney flue. The water is fed by Belleville pumps.

Fig. 1 gives a general view of one side of the boiler room. To the left may be seen the hoppers whence descends the coal, which is stored in bins in the loft.

The machinery room, of which Fig. 3 gives an internal view taken from one end, is a large hall 10·5 meters in height, 14 in width, and of a length that, at a maximum, will be 75 meters when all the machines are installed.

In this room there are at present five steam engines of 1,200 horse power each, to which, ere long, two more of the same power will be added. These engines, which are of the Corliss type, were constructed by the Alsatian Society of Mechanical Constructions, at Belfort. At a pressure of 8 kilogrammes per square centimeter and an angular velocity of 70 revolutions a minute, they give an effective 1,100 horse power upon the driving shaft. A gallery provided with a stairway is installed at the height of the cylinders for the service of the engines. Between each two engines there is a board upon which are placed the pressure gages and indicators. The driving shaft carries on one side a 31-ton fly wheel of a diameter of 5·7 meters and on the other the dynamo machine of which we are to speak. Each engine is provided with an injection condenser with a simple acting vertical air pump. The consumption of steam is 6·5 kilogrammes per indicated horse-hour. Below the engines there is a basement that permits of access to certain parts of the dynamos. Let us add that each steam engine is provided at the side with a small auxiliary machine designed for putting it at the starting point.

The dynamo machines, which likewise were constructed by the Alsatian Society, belong to what is called the external collector type. The armature, which is in the form of a Gramme ring held at the sides by a cast iron disk with 39 arms, revolves outside of the fixed inductors, which are formed of 12 polar pieces. Each dynamo gives 1,500 amperes at 500 volts, say 750 kilowatts at 70 revolutions per minute.

A lateral gallery, placed in the basement of the engine room, receives all the cables of the dynamos and leads them to the distributing tablet, the principal arrangements of which are seen in Fig. 2.

The distributing tablet is installed on a balcony which is reached at each end by stairways, and which is placed above the office of the engineers. It is formed of a large slab of marble of which the left hand side alone is occupied for the present. Our engraving represents the installation as it will be when the machine room contains its ten engines. In the panel reserved for each dynamo is seen, at the bottom, an excitation rheostat and various maneuvering buttons, and, above, a hand interrupter and a magnetic one, and a special voltameter commutator. Upon the left side, opposite each dynamo (Fig. 3), there are frames with plates of ground glass upon which are inscribed the orders: "Start," "raise," "lower," "stop." Behind each of these words there are, respectively, yellow, red, blue and white incandescent lamps, which are controlled by the buttons that we mentioned above. The head electrician thus gives the man in charge of each engine all the orders necessary for running the latter, and no order is communicated by voice. All the machines are regulated and coupled in tension at the distributing tablet of which we have just spoken.

The starting tablet for the feeders is connected with another tablet upon which are found the measuring and controlling apparatus for the outgoing lines. This tablet is installed in a lateral gallery with a view to supplying two machine rooms later on—the present one and another one on the opposite side. It now contains two panels with three feeders to each, for the Saint Roch and Mauconseil substations. On these tablets there are a feeder rheostat, interrupters and voltameters connected with control wires at the point of attachment of the feeders. These latter are formed of cables of 1,000 square millimeters. These cables, which are covered with lead, are placed directly in the ground. At their exit from the tablet they pass into a large subterranean gallery, where they are fixed at the side. This gallery ends at the side of the canal and is designed to receive, later on, a carrier that will obtain coal directly from a crane and take it to the foot of an elevator designed to supply the bins placed over the boilers.

In all that precedes, we have occupied ourselves only with the machinery building properly so called. It remains to say a few words concerning the second structure parallel with the first, and which will form the central building after the right wing of the works has been constructed.

In the basement of this building, in the prolongation of the starting gallery of the cables, there is a room for

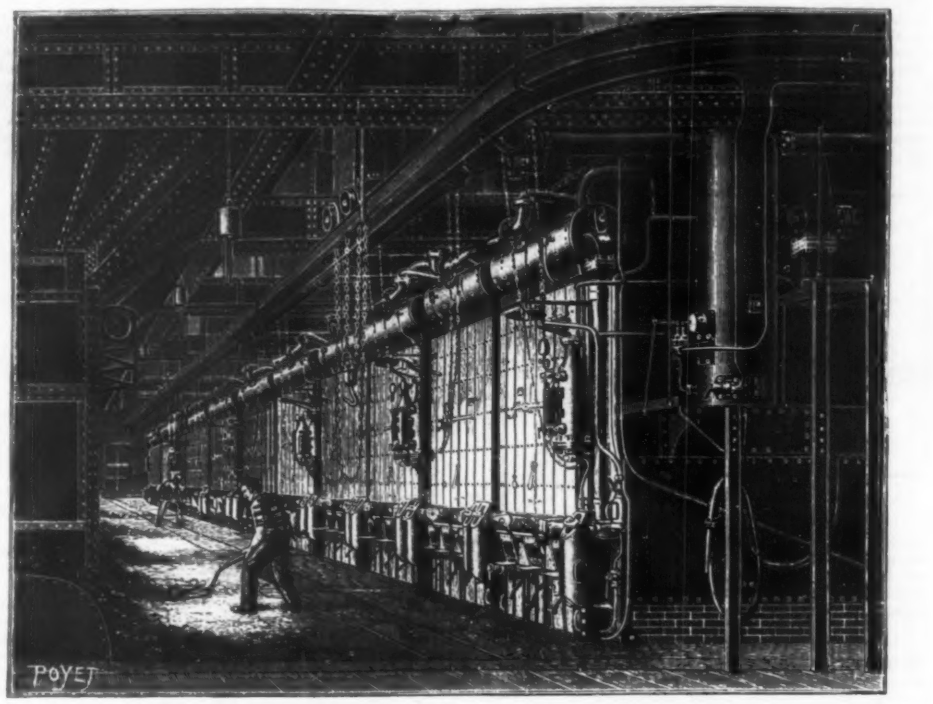


FIG. 1.—VIEW OF ONE SIDE OF THE BOILER ROOM OF THE QUAI JEMMAPES WORKS.

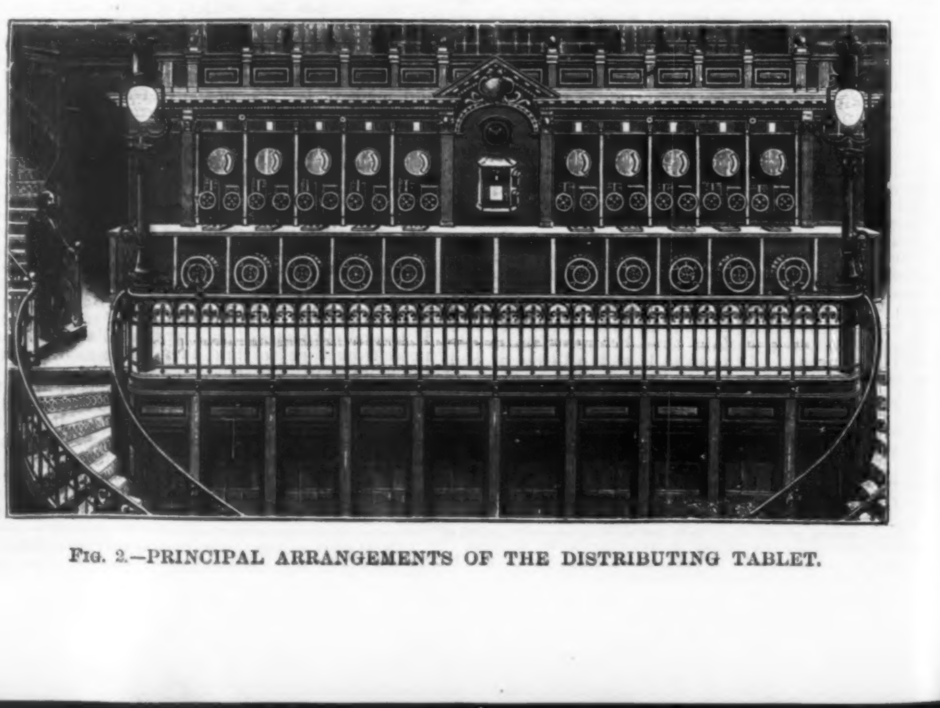


FIG. 2.—PRINCIPAL ARRANGEMENTS OF THE DISTRIBUTING TABLET.

* The more technical treatment of these and other results is to be found (appearing from time to time) in The Psychological Review (Macmillans) and in Princeton Contributions to Psychology (published by the University).

the reservoirs of purified water and the elevators. On the ground floor are the purifiers, the lifts and a shop for mechanical repairs.

SYSTEM OF DISTRIBUTION.

In conclusion, we shall give a few data as to the new system of distribution adopted by the company. At the central station of Quai Jemmapes the five dynamos can be coupled in quantity upon the tablet. At its exit from the bars of the coupling tablet, the current passes into the feeder tablet, and can be sent directly into the feeders, to the number of six of 1,000 square meters (three for the Mauconseil and three for the Saint Roch substation), either through interrupters or special rheostats, according to the requirements of the service.

The substation of Rue Mauconseil, in the Quartier des Halles, contains four groups of four batteries, each of 280 accumulators of the Society for the Electrical Working of Metals. These accumulators have a capacity of 2,200 amperes-hour, and are capable of furnishing a 300 ampere discharge. The charge is made either directly by the feeders coming from the works or by the aid of supervolters.

The Saint Roch station is supplied by the feeders of the Quai Jemmapes works. It likewise possesses rotary transformers, of which the primary circuits are supplied by the high tension line from the Boulevard Richard-Lenoir and Saint Fargeau works, the secondary circuits of which are coupled in quantity with the batteries of accumulators.

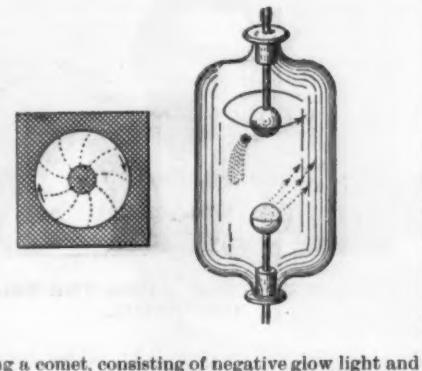
From the substations start five-wire subfeeders which supply the distributing line at various points. The regulation of the difference of potential is effected by means of batteries of accumulators. Upon the distributing line are branched the various apparatus of utilization, at 110 volts for incandescent lamps and at 440 for motors.

Such, upon the whole, are the principal arrangements of the very interesting distribution of electric energy that has just been installed at Paris, upon a scale of grandeur and under most remarkable conditions, by the Parisian Compressed Air Company.

For the engravings and the above particulars we are indebted to La Nature.

MAGNETIC WIND.

THE explanation of the phenomenon of "electric wind," meaning the discharge from points accompanied by a blast of air, has taxed the successive theories of electric discharge to the utmost. That air can be electrified, says The Electrician, has been generally denied by the more recent workers, and the effect upon air has, since Helmholtz, been attributed to a dissociation of the gaseous molecules. Unless a higher than atomic dissociation is assumed, this hypothesis meets with serious difficulties in the case of monatmoic gases. There remain the wave theories sketched out by Hertz, Goldstein and others, which embrace all vacuum discharges. But O. Lehmann has recently carried out an investigation of the phenomena of electric and "magnetic" wind which tends to put these theories out of court. It appears that the air currents between two opposed points, made visible by tobacco smoke, or by a heavier gas, can be explained by the projection of two opposed currents of particles or ions, which produce a motionless layer in the middle. If for any reason a layer of air acquires a different dielectric capacity from the rest, partial discharge takes place within it, which gives the appearance of a stratified discharge. Electric wind is the cause of the unsymmetrical shape of the arc, which is blown away from the negative pole. If the electric wind occurs in a strong magnetic field, the stream lines of the ions, and hence also of the air, must be changed in obedience to the electromagnetic forces, since a moving ion is equivalent to an electric current. This may be well shown by means of the arc, which rotates in a magnetic field originally devised by Andrews. One of the poles is a plate with a circular perforation, the other is a carbon rod with its end in the center of the circle. The arc playing between the rod and the inner edge spins round rapidly in a magnetic field with its lines of force parallel to the rod. If an alternate current with 100 reversals per second is used, it often happens that the arc spins around 50 successive times in the same direction between every two reversals. The spiral paths of the carbon particles show that it is a case of magnetic wind, and not an influence upon an ether phenomenon. In a large highly exhausted "electric egg" the author recently noticed a curious phenomenon in this connection. It was an appearance re-



sembling a comet, consisting of negative glow light and a brush or tail, which projected from the cathode in an eccentric direction. On approaching a magnet to it from the outside it began spinning round the axis of the vessel, the rate increasing with the proximity of the magnet and reversing on reversing the poles. The author, Dr. Lehmann, seeks an explanation in the eccentric impact of a stream of air upon the cathode.

AMERICAN BELL TELEPHONE.

THE report of the great telephone organization of this country for the year 1897 is of the character to cause satisfaction to its stockholders. The record presented is one of increasing business and exceptionally large gains in the earnings of the corporation. In fact, the increase in the number of stations and telephones for the year was unprecedented, a fact which points to the influence of increased business activity upon the use of the telephone as an adjunct to commerce and to the equally marked effects of renewed prosperity throughout the land upon its employment as a social and domestic necessity. The facts in this connection speak for themselves. According to the report, the number of instruments under rental on December 20, 1897, was 919,121, compared with 772,627 the year before, an increase of 146,494 telephones. The number of exchanges on January 1 of the present year is given as 1,025, compared with 967 exchanges at the beginning of 1897, an increase of 58, while the branch offices now number 937, or 105 more than they did a year ago.

The earnings of the company, derived from rentals of telephones and dividends upon the stocks of the operating company principally, tell a similar story. The aggregate gross receipts of the American Bell Telephone Company for 1897 were $5,130,844, an increase of $803,520. To this sum rental of instruments under the plan adopted by the corporation of leasing all telephones contributed $1,597,959, an increase of $359,581, and the dividends paid on the stocks of subsidiary companies owned by it reached a total of $3,085,379, or $469,072 more than the receipts from that source in the year 1896.

The financial details presented with the report show that the expenses for the year, which item included interest upon the $2,000,000 of debenture bonds, taxes and other items, amounted to $961,170, or about $17,425 more than in the preceding year, leaving net earnings of $4,169,674, an increase for the year of $776,093. The capital stock of the company was increased during 1897 by the issue and sale of $2,236,340 in shares, making the amount outstanding at the end of the year $25,886,300. The regular dividends of 12 per cent. per annum and 3 per cent. extra were paid on the stock, making the total on that account $3,682,948, an increase of $412,387; $47,000 was charged off for depreciation and other items, and as a result of the year's operations $439,500 was carried to the company's surplus account, which now amounts to over $2,590,000.

A considerable portion of the report is devoted to the details concerning the extension of the Long Distance Telephone Company's lines, which now reach as far as Minneapolis and Omaha on the north and west, and southerly to Petersburg and Norfolk (Virginia). The total mileage of pole lines operated in that connection is 8,778 miles, with over 116,000 miles of wire, connecting 238 offices, or 55 more of the latter than at the close of 1896. The amount of new construction completed in 1897 by all the companies having relations with the American Bell Telephone resulted in an outlay of no less than $8,700,000, while the entire expenditure for construction at the close of last year reached the large total of $97,946,000. Included in this latter sum was over $13,800,000 on account of the Long Distance Telephone Company, which organization, it is stated, increased its gross earnings during the year by 16 per cent., or some $1,897,000. Even this brief summary is an indication of the enormous proportion which the telephone industry in the United States has attained, as well as of the prosperity of the corporation that enjoys a practical monopoly of the business.—Bradstreet's.

ARTIFICIAL COLORING OF FOOD PRODUCTS.

THIS important question is treated from a sanitary standpoint in The Dietetic and Sanitary Gazette, from whose article we make the following extracts:

"Among the important questions that have arisen in consequence of the attention given to the composition of food products, is that of artificial coloring. Much of the coloring of food is traditional and æsthetic and is not intended to deceive. Thus candies are obviously colored to please the eye, especially giving variety to the confectioner's stock; butter and mustard are colored without any intention to deceive as to quality or purity. Of course the imitations of such articles are also colored, but the primary intention to deceive is in the manufacture of the substitute. On the other hand, colors are often used to conceal inferiority or falsification. Skimmed milk is colored to give the appearance

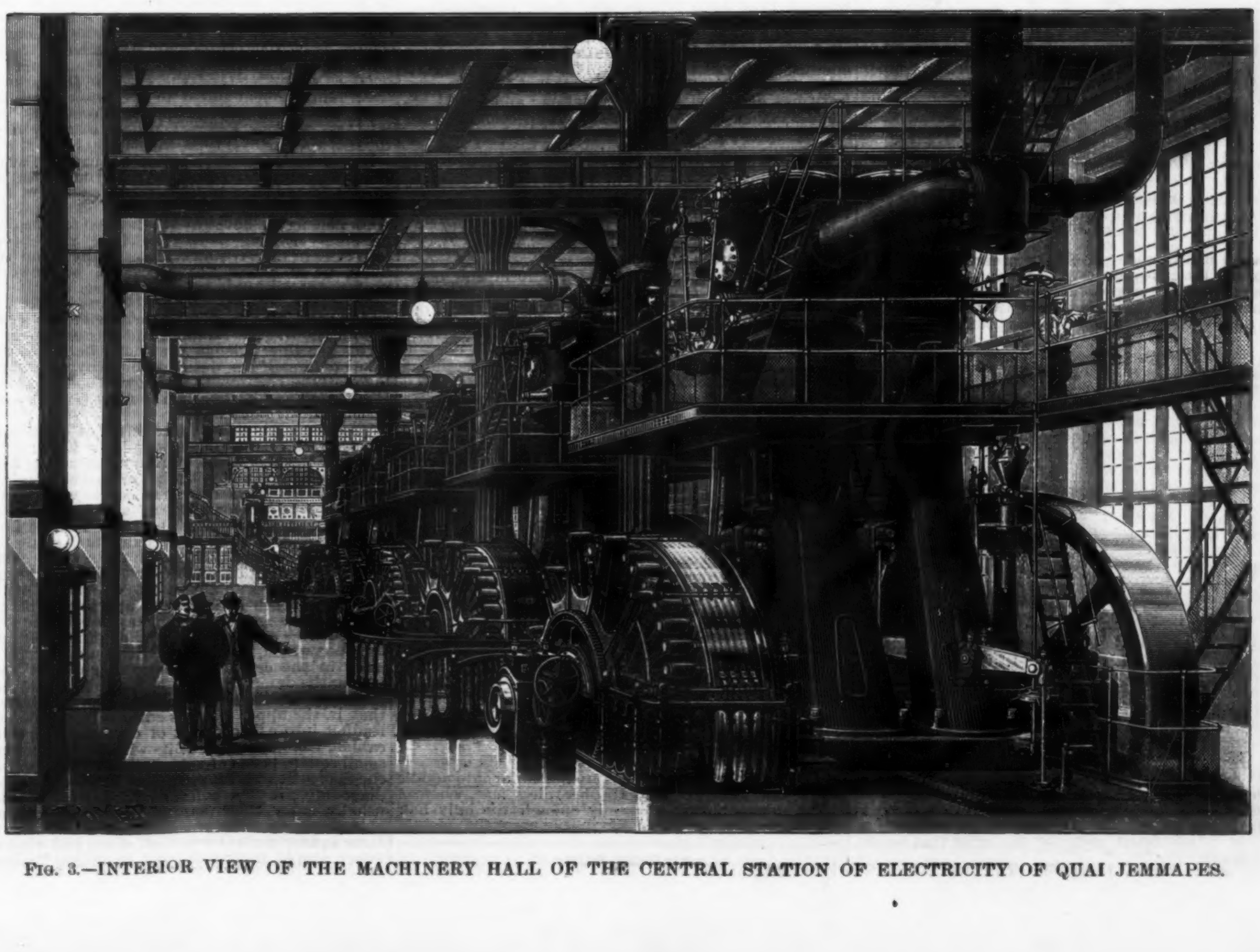


FIG. 3.—INTERIOR VIEW OF THE MACHINERY HALL OF THE CENTRAL STATION OF ELECTRICITY OF QUAI JEMMAPES.

of richness; dilute alcohol is colored to imitate wine, and acetic acid is colored to imitate cider vinegar. The sanitary chemist must carefully distinguish between these two purposes in the case of colors. With candies, butter, mustard and similar instances, the question is the wholesomeness of the color used, but the coloring of milk or spirits is essentially a deception to the injury of the buyer or user, and may be prevented on that basis alone without reference to the wholesomeness of the color used."

We are reminded by The Gazette that the colors mostly used at present are the so-called coal tar colors, of which it says:

"There are very many forms, and the number is rapidly increasing, as the result of the scientific research carried on in Germany, which has long led the world in this industry. The composition of these colors is generally highly complex, and their systematic names long and awkward, for which reasons they are generally sold under trade names that give no indication of their composition or relationships. The colors produced in the earliest period of the industry were not permanent and were liable to dangerous impurities, especially arsenic, but the modern products are more permanent and purer. Features that are common to many are solubility in water and high coloring power. These make them suitable for use in food, and we find, therefore, that they have come largely into use as food colors, and the detection of them and judgment of their effects are often problems presented to the food analyst."

Obviously it is most important to determine the effect of these colors on the human system, but, in the opinion of our writer, this has never been properly done, those who assert that the colors are unwholesome or poisonous relying on experiments made with impure materials, or on those made by injection without antiseptic precautions, or on those in which large doses were given instead of the almost infinitesimal portions used in food coloring. The writer concludes as follows:

"It is our opinion, therefore, that there is no good reason for regarding the standard coal tar colors as unfit for use in food. The quantity is so small that it is not reasonable to suppose that any toxic effect will follow. The probability is that many of these colors are analogous in composition to those found naturally in fruits, flowers and seeds, and it is mere assumption that the natural colors are more wholesome than the artificial. Of course, it is taken for granted that the colors are free from mineral impurities; that point can be readily ascertained, and the commercial colors are now almost all satisfactory in this respect. All the coal tar colors, being organic, are readily decomposed in the system, and hence cannot act as cumulative poisons. It seems, therefore, that it is at present merely the duty of sanitary authorities to ascertain what colors are used and in what amounts, and that restrictive action is not called for."

RESPIRATORS FOR PREVENTING THE INHALATION OF DUST.

SOME time ago the Association des Industriels de France opened a competition for the production of a

FIG. 1.—WORKMAN PROVIDED WITH A DETROYE RESPIRATOR.

respiratory mask which should, in a certain measure, prevent the lung troubles due to the inhalation of the dust floating in the atmosphere of manufacturing establishments. The prize was taken by Dr. J. V. Detroye, a veterinary surgeon of the city of Limoges, who made some very interesting anatomo-pathological and prophylactic studies upon the dust of porcelain works and its action upon the organism. Dr. Detroye has recently introduced some improvements into his apparatus, and it is of the latest styles of the latter that we desire to speak.

His respirators originally consisted of separate nasal and buccal protectors. M. Bellot, the manufacturer of the apparatus, has brought out a new type in which the two masks are united. In Nos. 1 and 2 of Fig. 2 are shown an internal section and external view of the nasal respirator and in Nos. 3 and 4 the same views of the buccal apparatus. These respirators, which are of malleable aluminum, 0·2 inch in thickness, are very light, their weight being at a maximum a little less than one ounce. The flexibility of the metal permits of their adaptation to the different surfaces to which they are to be applied. A slight pressure suffices for putting them in place. The filtration of the vitiated air and the arrest of the dust is effected through a layer of prepared cotton placed between the double open-work sides of the apparatus. The edges of the masks are provided with a pneumatic tube that permits of their being applied firmly to the

FIG. 3.—METHOD OF USING THE BELLOT RESPIRATOR.

face. They are likewise held by rubber bands that pass around the ears (Figs. 1 and 2).

The nasal respirator may, if need be, be provided with a valve at its upper part in order to allow the products of respiration to escape to the exterior. This valve is quite necessary if the apparatus is to be worn for some length of time.

These respirators are strongly constructed and are adapted for everyday use in the workshop or manufactory. The cotton must be renewed often enough to prevent the dust, upon filtering through it, from entering the interior. The experiments that have been made with these apparatus have given most excellent results, says La Nature, from which we borrow the accompanying illustrations and particulars.

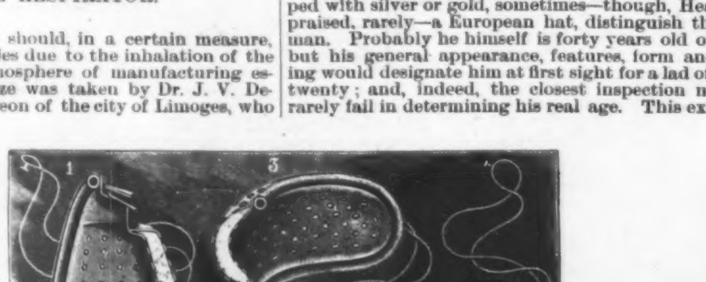


FIG. 2.—DETROYE NASAL AND BUCCAL RESPIRATOR.

[Continued from SUPPLEMENT, No. 1167, page 18684.]

MALAY LIFE IN THE PHILIPPINES.*

By W. G. PALGRAVE.

THIS is not the place for me to enter on the perilous field of the strange abnormal practices and beliefs, survivals of a far older creed, that subsist and smoulder on throughout the archipelago, and even within the immediate neighborhood of Manila itself, its convents and cathedral, beneath the christianized surface, though rarely obtruding themselves on European observation: Cybelian priesthoods, Cotyttian rites, repressed but not obliterated, and to which the past history of other nations, perhaps the present, offers many a parallel. Enough that such things are; their investigation, though of deep anthropological interest, is foreign to my present scope, which extends only over the usual, not the exceptional, the recognized, not the concealed and disavowed, phases of Philippine society and life.

Mass is ended; the "Royal March" of Spanish celebrity has dismissed the congregation; and, while we stand a little apart and watch the bright-colored crowd issuing dense but orderly from the church portal, the native gubernadorcillo or capitan, the head man of the village community, observes and approaches us. The ensigns of his office are few, and those chiefly Spanish; a short jacket of black cloth, worn, unbecomingly enough, over the indispensable blouse, a thin staff tipped with silver or gold, sometimes—though, Heaven be praised, rarely—a European hat, distinguish the great man. Probably he himself is forty years old or more, but his general appearance, features, form and bearing would designate him at first sight for a lad of barely twenty; and, indeed, the closest inspection may not rarely fail in determining his real age. This extraordinary semblance of juvenility, prolonged far into middle life, is not merely due to the beardless face, where a slight mustachio is commonly enough the only hair growth even in advanced life, but more to the smooth, smiling, unworn features, where neither care nor passion seems to have left a trace, and partly to the uprightness of stature and well proportioned roundness of limb maintained to the very confines of senility—a fitting exterior to the calm, unexcitable, moderated character within, and not unparalleled among the Chinese, Japanese and other Turanian tribes. It is almost a pity that early and frequently recurring maternity too generally deprives—though not uncompensating in its kind for what it takes—the Malay women of a physical advantage more to the purpose in their sex than in the male.

Every village, large or small, is headed by its capitan, a native of the place or district, elected, in accordance with immemorial custom, for two years' office by the villagers themselves, subject, of course, to the approbation, seldom withheld, of the alcalde, or Spanish provincial governor. For the Spaniards, wisely enough, preferred at their conquest to maintain and continue in most matters of detail the already existing village or barangai organization, rather than to supersede it by novel systems of their own; a matter in which they showed themselves to be better colonizers than, for instance, the French. But the post of capitan, however important, is scarcely an object of rural ambition, as its responsibilities are at least equal to its dignity; while the expenses which custom or duty has rendered obligatory on its holder are too often in excess of its emoluments, legal or not. Hence the not unfrequent nolo episcopari—that is, its Tagal equivalent—of a newly elected capitan.

Of even higher authority in every village than the capitan himself is the cura, or parish priest. He is in most instances a Spaniard by birth, and enrolled in one or other of the three great religious orders, Augustinian, Franciscan or Dominican, established by the conquerors in these islands. But his birthplace, complexion and habit apart, he is ordinarily as much, sometimes in a manner more, of a native in his sympathies and turn of mind than the natives themselves. This is quite natural. Bound for life to the land of his adoption, with no social, no domestic tie, no anticipated home return to hold him back from identifying himself with those among whom his days are henceforth to be passed, his bones at last to rest, having every interest, the highest as the lowest, in common with the sheep of his pasture, whose fleeces he cannot but desire to guard against all other shears but his own—and, to do him justice, his own do not shear very close—he commonly becomes, and that in the truest and best sense of the term, a very father to his people, and finds in their reverence and affection motive enough to encourage him in continuing to deserve the title. To clerical government, paradoxical as the statement may sound in modern European ears, the Philippine Islands owe, more than to anything else, their internal prosperity, the Malay population its sufficiency and happiness. This it is that again and again has stood a barrier of mercy and justice between the weaker and the stronger race, the vanquished and the victor; this has been the steady protector of the native inhabitants, this their faithful benefactor, their sufficient leader and guide. With the cura for father and the capitan for its adjutant, a Philippine hamlet feels and knows little of the vexations inseparable from direct and foreign official administration; and if under such a rule "progress," as we love to term it, be rare, disaffection and want are rarer still.

Occasionally the cura is a native by birth, for though excluded by invariable custom and monastic disciplinarianism from the "regular," Malays are admitted readily enough into the ranks of the "secular" priesthood. But, while pointedly rejecting as the figments of a malevolent imagination the calumnies of Jagor and his like against the morals of the Philippine clergy in general, and the native portion of it in particular, I must admit that the results of Malay ordination are seldom as satisfactory as could be desired. The Malays have, in their authentic condition, no regular priesthood, as we understand the word, of their own, nor is their temperament suited to it. The office is accordingly best filled among them by foreigners, such at least as religious orders and monasticism, nor least those of the Spanish type, can supply.

But we have almost forgotten our capitan, who, with genuine Malay courtesy and self-restraint, has been all this while awaiting in silence and respectful expectation the opportunity of addressing us. This he now does, placing his house at our disposal for the day, and pressingly inviting us to take share in the promised festivities of the evening. Knowing as we do that the house he so liberally offers us will be crowded with visitants of all kinds, on ceremonious compliments or indirect business, we decline the first half of his offer and request for ourselves some quieter shelter till the evening hour. He complies and passes us over to one of his wealthier friends, who immediately proceeds to take on himself the duties of host, by vacating in our favor all the best rooms of his own abode, and converting himself and his family into extemporized cooks and servants during our stay.

The house, though ranged in what constitutes the main street of the village, stands by itself; no Malay who can possibly avoid it ever constructing his home in immediate contact with that of another family. The garden which surrounds it, fenced in with wattle, and thick set with dragon's blood plants, purple blossomed creepers, red coral plants and white starlike flowerets, makes a pretty show; betel palms and giant bananas shade the inclosure. Raised on thick pieces of stone or wood to a height of six or eight feet from the ground, the house enjoys an almost free circulation of the outside air beneath its inhabited apartments on the first floor; an arrangement which may possibly be a survival of lacustrine constructions and delta-inhabiting ancestors, but which, now observed throughout the Philippines in the driest up-country heights not less than among the dampest marsh lands, contributes not a little to popular cleanliness and health. The house itself, that is, the upper story, is entered by a wide staircase leading into a broad sort of open passage, called the cahida, facing the street; its windows are composed of small square panes of thin mother-of-pearl, produce of the Sooloo Seas, arranged in latticework horizontally or diagonally; in this cool, verandalike passage the family usually enjoy their leisure, receive visitors and exchange gossip with the neighbors. Behind it is a large square central room, all doors and windows, the latter also of mother-of-pearl in sliding frames; here

* In Cornhill Magazine.

are massed together the costliest articles of furniture owned by the household—chairs, tables, wardrobes and the rest. As might be expected of a people whose principal constructive material is wood, the Malays display considerable skill and taste in carved work; even the outside decorations round and between the windows and along the string courses of their buildings are often of much beauty; while indoors their cabinets and sideboards, well proportioned and elaborately intricate in decorative finish, might not rarely furnish models to be copied or envied by the upholsterers of Europe. The narrow interspaces along the walls of the principal room are decorated with colored prints, generally Spanish, devotional or historical, as the case may be; and not rarely boast of family portraits, executed by native artists, with all the detail accuracy and all the stiffness and want of perspective that a Chinese could accomplish. Glass globes, red and blue, mixed with gay lamps, and perhaps a European chandelier, hang from the ceiling, and a small tinsel-decorated altar or oratory, the penates of the family, commonly occupies a corner of the apartment. The doors around open into bedrooms, and a bamboo-made passage leads off to the bathroom and kitchen, which is also on the first floor, but at a little distance from the rest of the house.

Abundance of light, though tempered by the semi-opacity of the pearl-shell windows, plenty of fresh air, as much bright color and ornament as can be had, and scrupulous cleanliness, the broad-floor planks being daily scrubbed with plantain leaves to a mirrorlike polish, and everything dusted twice in the day—such are the chief characteristics of the interior of a Malayo-Philippine house; and amid conditions of this sort, the general health and longevity of the inhabitants cease to surprise. Outside, the appearance of the many-gabled, palm-thatched roofs at every variety of pitch, the widely projecting eaves, the bamboo interlacements, and carved timber work of the walls, the checkered panes and little balconies here and there, is very picturesque, and has a kind of Swiss-cottage look that harmonizes well with the local background of hill and forest.

I pass over the ceremonies of reception, and the hospitality that follows; both are in the main identical with those practiced elsewhere in the non-Europeanized East, with the difference that here the women of the house take a more prominent part in welcome and entertainment than is customary in Syria, Arabia or Western Asia generally. When not under Mohammedan influences, Malays draw the line of demarkation between the sexes but slightly; and Christianity naturally tends to efface rather than to deepen the division. To this circumstance, more perhaps than to any other, I am inclined to attribute the manifest superiority in mind, and even in body, of the average Philippine Malay over his Mohammedan kinsmen, as the latter are found in Sumatra, the peninsula, the Sooloo Archipelago and adjoining regions.

That the adoption of Islam may be, and in fact is, a real benefit and an uplifting to savage tribes, among whom the lowest and most brutalizing forms of fetichism would else predominate, does not admit of doubt. Anthropophagy, human sacrifices, and other kindred horrors, have thus been banished by Mohammedan teaching from whole tracts of Africa; and so far is well. But not less does experience show that, sooner or later, the tribe, the nation, that casts in its lot with Islam is striken as by a blight; its freshness, its plasticity, disappear first, then its vigor, then its reparative and reproductive power, and it petrifies or perishes. With the abstract and theoretical merits of monotheism or polytheism, Islam or Christianity, I have nothing to do; but this much is certain, that within the circle of the Philippine Archipelago itself—not to seek examples farther away—the contrast between the Mohammedan villages of the southernmost islands and the Christian ones elsewhere is very remarkable, nor by any means favorable to the former.

For a satisfactory explanation of the problem before us, there is no need for recurring to causes, if such there be, hid in the extra mundane and unknown. The reason is near to seek. Family life, family ties, family affections, these form the only true, stable and at the same time expansive basis for communities, states, empires even; and that these may and actually do coexist after a fashion with a vigorous profession of Mohammedanism, no one who has experimental knowledge of Turkish or Arab populations can possibly deny. They exist; but even when at their best and strongest are always cramped, stunted and hindered their full growth and development by the forced demarkation between the sexes, the sanctioned polygamy, the over-facility of divorce, and the other social mistakes interwoven, whether by the hand of the Prophet himself, or rather, as with Sprengel I incline to believe, by that of the narrow-minded and ascetic Omar, into the very texture of Islam. Nowhere are family bonds closer drawn, family affections more enduring, than among the Malay races; and nowhere, in consequence, is whatever weakens or distorts them more injurious. Hence a Malay Mohammedan is a contradiction, an anomaly, a failure, much as a Hindoo Christian or a European Buddhist might be. The system does not suit him, nor he the system. Not so the Malay of the Philippino-Christian type. His family, as that of his Chinese or Japanese cousins, moderate polytheists like himself, is a pleasing sight, much subordination and little constraint, unison in gradation, liberty, not license. Orderly children, respected parents, women subject but not suppressed, men ruling but not despotic, reverence with kindness, obedience in affection, these form a lovable picture, nor by any means a rare one in the villages of the Eastern Isles.

Our midday meal, the components of which differ little from those of a West Indian or a Bombay up-country menu, with cookery to match, is over. Follows, for those who desire it, a dreamy half siesta of cigars and the green coolness of rustling bamboo sprays outside the window, with glimpses of a shining river and light outrigger canoes gliding over it just seen betwixt the leaves; a purple volcano peak and a faint blue mountain range beyond. And now the white perpendicular glare of noon is slanting into mellowness, and we stroll out of doors for a survey of the village, keeping whenever we can under the shade of the thick planted garden trees, mango, palm, orange, lanzon, santol, medlar, fifty more, each with its own peculiar foliage and fruit, pleasant to the eye and good to eat, a survival of Eden.

The villagers' houses, some large, some small, wood or bamboo, two-storied or one, mere huts or spacious dwellings, according to the fortunes of the inmates, are jotted here and there in an unsymmetrical row among the trees with utter disregard of proportionate dimensions; but all have a comfortable, a cozy look, suggestive of sufficiency; many of them, white, painted with stripes green or blue, rarely red, and occasionally a flower pattern or fanciful scroll work to enliven them more, show an attempt at decoration; others are content with the pale yellow of the split and interlaced bamboo that forms their walls; the roofing is gray palm thatch. On this festival day lamps are placed ready for lighting at every window, and over every doorway, flower garlands hang between, and frequent arches of cane, festooned with white or red cloth, and hung with lanterns of more colors than Joseph's coat, span the road.

We have left behind us the white church and "convents," the capitan's many-windowed house, the guard station, where a couple of brown young policemen, natives, of course, but attired in Spanish military uniform, languidly keep what courtesy may name watch, and now we have before us a large wattled building, surrounded by a wide inclosure, and with extensive galleries in front and on the sides; the central thatch roof towers domelike above the rest. Several natives, clad, for the day is yet hot, in the gauziest and most transparent of hemp blouses, or absolutely naked to the waist, are entering the crowded gateway, others are issuing from it, like bees about the mouth of a hive; all is animation, almost—so far as the word is compatible with Malay composure—excitement. It is the village cockpit, the great afternoon resort of Sundays and holidays as observed throughout this entire region of the world, from Penang to the confines of New Guinea; in the Philippines most of all.

Whether the Malays, as some writers assert, learned cockfighting from the Spaniards, or the Spaniards, as others opine, from the Malays, I will not attempt to decide; the historical problem is too complicated. But from whichever the origin of the sport, it is certain that the zeal for it that nowadays glows in every native breast from Luzon to Mindanao, let alone the rest of Malaysia, is such as might rejoice the soul of a Windham himself. Rich or poor, it would be hard to find a Malay householder, Ilocan, Tagal, Visaian, or whatever his tribe and island in the great Spain-governed archipelago, who does not rear at least as many fighting cocks as his means permit, and too often rather more; nor is it wholly a calumny which asserts that the owner is wont to tend his bird better and love it dearer than any other living object of his household belongings, wife and children not excepted. Stories are current of a respectable Malay paterfamilias escaping from amid the ruins of his burning home—no rare occurrence in these villages of wood and thatch, especially during the dry season—and bearing carefully shielded in his arms his favorite, scarce-rescued bird, while his wife and children are left behind to shift for themselves unheeded as best they may. Exaggerations, as I am bound to say, but, I also fear, "founded on fact."

We enter the precincts—the admission fee is a mere trifle, and a cheap cigar, if no coin be at hand, is current payment for this and for many other minor costs—to see the sport. It has been often described; the chief thing worthy of remark is that a heel of either fighting bird is armed with a sharp razorlike steel blade, nearly two inches in length; a deadly weapon, that materially abridges the duration of the combat between the feathered rivals. Once at close quarters, the rest is an affair of seconds rather than of minutes; at least I never saw it otherwise. It is a somewhat brutal amusement, after all, and so far lowers the Malays to the level of our own ancestors some three or four generations ago. But the really worst picture of a Philippine cockfight is the betting universal among the spectators of the game; the sums staked are often very high, and their payment, which is rarely shirked, not uncommonly involves the ruin of the loser. Thus the cockpit too frequently proves the first step in an Avernian descent leading down to prison and crime.

Here we have in truth before us the Malay "turf," though Malay civilization has not yet widened enough to include within its circle "welchers" and their kin, nor, I think, ever will. Self-respect, a feeling hardly ever absent from the national character, would alone suffice to forbid it. The same self-respect displays itself, too, even on occasions like the present, when, if ever, it might be supposed weak or wanting, in other ways. Look round the crowded circles, where several hundreds of half naked spectators of every age are closely packed together in the broiling afternoon heat, and acted on by all the combined influences of gambling, emulation and the sport itself; not a word, not a sound, is to be heard, not a gesture to be seen, approaching to "rowdyism;" not a hint of disorder or disturbance. Passions, strong ones too, certainly, are at work; vice in many forms can hardly fail to be present and busy in gatherings of the kind; but no vulgarity, no visible or audible coarseness are there.

This is partly due to the comparative absence of intoxication; for tuba, the fermented palm juice that does almost universal duty for beer or spirits among the Philippine "natives," is rarely drunk in excess, and, even were it, could hardly prove more effective than in Dr. Johnson's estimation, claret itself. But the chief order preserver is the stable equilibrium of the native mind, the decorum born of moderation. A Malay may be a profligate, a gambler, a thief, a robber, a murderer; he is never a cad; that type, as well as the "rough"—the death-bed abhorrence of the great Queen of England's Renaissance—is a development of the "higher," that is, of the more muscular, more energetic, more pushing, more complicated races; and his absence from amid the equable diffusion of courtesy and self-restraint that stamp the average Turanian is alone no small compensation for the inferiority, if inferiority there be, of the gentler, calmer, less aggressive, also less progressive tribes. The adjuncts of an Epsom grand stand, or a Dutch kermes, may make one occasionally regret the less civilized but better mannered crowd of a Philippine fiesta.

(To be continued.)

AN EFFECT OF FROST.

ONE of our subscribers at Mulhouse, says La Nature, sends us an interesting communication in regard to an effect of frost that recently came under his observation, and that is of sufficient interest to make known. In the yard of a machine factory of the city there lay, during the cold weather, a cast iron cylinder cover having the form shown in Fig. 2, which represents it in transverse section. In the upper disk there were four apertures designed for the removal of the sand of the core after casting. The entire space marked by horizontal lines was filled with rain water, which, during a very cold night, froze solid. As the expansion of the water contained in the cover could be effected only through the four apertures above mentioned, there formed four columns of ice, which lifted the cake of ice in the upper hollow of the cover, and the whole assumed the curious shape shown in Fig. 1, which is reproduced from a photograph. The rough surface of the edges of the four apertures formed upon the exterior of the columns a number of well defined striæ, which may be seen, although imperfectly, in the photograph.

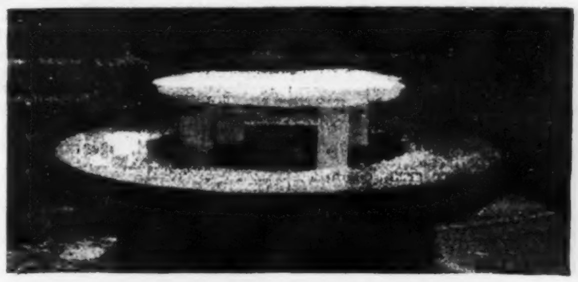


FIG. 1.—AN EFFECT OF FROST.

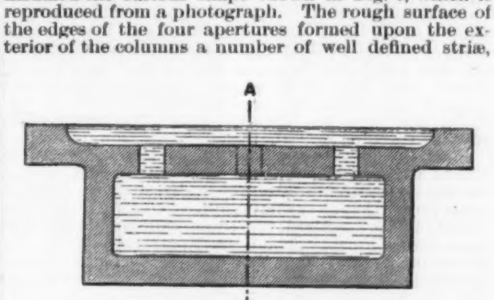


FIG. 2.—TRANSVERSE SECTION OF A CYLINDER COVER FULL OF WATER.

CHINESE GEOGRAPHY.

AGRICULTURAL countries originate great cities, because field cultivation leads directly to trade. The people have something to sell in a neighboring market town, and they exchange the produce of the soil for useful articles which they wish for at home. The largest cities are found where the soil is most fertile, and where the courses of rivers render conveyance most easy. When Baron Richthoven was in China twenty years ago, he studied with the experienced eye of a practical geologist the contour of China in all its provinces.

In the north, China presents the special features of the loess formation. A dull country, without trees, offers everywhere the singular spectacle of a rolling plateau with the occurrence of sudden fissures in the light, crumbling soil. Perpendicular walls line these breaks in the monotony of the land surface. They may vary from two hundred to seven or eight hundred feet deep. These water-worn fissures with vertical sides arrest the traveler's eye as a main feature in the geography of north China. Here and there they open out into plains where rich cultivation attests the industry of the farmer. The brooks of the higher lands become broad streams where two or more rivulets combine their forces. The mighty Yellow River is there to unite the ramifications of many tributary rivers which, starting from different points of the watershed, join to swell the volume of water as it rolls through five provinces to the sea.

What it is now, it was in Marco Polo's time six centuries ago. Six centuries before that it was the same when Arabs and Nestorians visited the court of the Emperor T'ang Ming-huang and his successors in the T'ang dynasty. When that renowned emperor, the patron of poetry and painting, escaped from his capital in Shensi to take refuge from rebellion in Chêngtu, the chief city then as now of Szechuan province, he left the loess country behind to penetrate into the wild and fertile west. But that was by no means a new experience to the Chinese inhabitants. The historians and poets of the country had described it long before. In the third century the story of the Three Kingdoms had made a deep impression on the native mind. China was then for the first time divided into three

parts, with an emperor to each. The main features in the geography are made in the north by the Yellow River, as in Central China by the Yangtzekiang. The traveler, as he obtains ideas of a more general nature of the geography of the country, learns to combine the Yellow River with the loess formation in the north just as he connects rice cultivation with broad alluvial tracts watered by the Yangtzekiang in Central China.

In the Han dynasty from B. C. 200 to A. D. 200 we find ourselves arrested by the spectacle of Yellow River embankments broken through and restored in times of destructive floods. We ask, Are we now at the beginning of Chinese geographical history? Far from it. The poets and historians of that time engaged earnestly in the task of restoring the records of antiquity and recovering from those records the geographical facts of more ancient times. They were the friends of knowledge as Chin Shi-huang, the Book Burner, was its enemy. He was like the Caliph Omar who ordered the fire to be kindled at Alexandria that burned the books of the Greeks. They were both savages who richly deserve the dishonor heaped on them in later ages, for they, being the enemies of knowledge, were the enemies of man. Even Confucius himself, that reverent student of antiquity over 2,300 years ago, traveled among the same scenes of which Von Richthoven has now for the first time given us exact pictures.

In one of his drawings we see several sailing boats on the winding Yellow River in the eastern part of Honan Province. On the right hand is a long loess wall apparently ten times the height of the sailing boats, and presenting two distinct terraces about equal in thickness one above the other. Near some cottages, surrounded by trees on the north bank of the river, we can see the perpendicular fissures in this loess wall quite distinctly. In another of Richthoven's pictures we look out from the door of an archway upon a sea of loess terraces vertically cut. Through them the mule path winds down the archway, and it will soon be passing between vertical walls several hundred feet deep as it goes forward through this singular formation; so utterly unlike what we are accustomed to notice in our own country.

Through such scenes 2,350 years ago Confucius formerly traveled with his pupils. But was this as far back as we can go if we wish to know what ancient geographical records the Chinese possess? No. Confucius himself was a loving student of antiquity. The classics as he read them belonged to all the preceding ages, since about B. C. 2200. These books were the treasures of the famous Chinese sage; among them is the "Yü-kung," a most valuable geographical fragment. It sketches all north and central China. There is not an important mountain, a river, a lake, which it leaves unnamed. The wonder in regard to the "Yü-kung," as Richthoven has carefully pointed out, is that 4,100 years ago the Chinese knew their own country in its topography so remarkably well that the book itself, and the facts it contains, with the language and style of its composition, are thus shown to belong to the age which the Chinese themselves assign to it. There must have been imperial government in the days of Yao and Shun and of the Hsia dynasty, as tradition says, and this account of the geography must come down to us from that time.

Four thousand years ago the writers of this old record knew all China from Szechuan and Kansu to the sea near Shanhaikuan in the Gulf of Pechili. A large proportion of the names of mountains and rivers found in this book are the same that are applied to them now. Four thousand years ago the principles of government were such that the whole country was minutely known to the administration. The language was Chinese and the writing used was Chinese; the principles of government were so much the same as now that if a native scholar is asked when the country first began to have nine ranks of officers, five orders of nobility and a system of administration like the present, he will reply that it is all in the "Book of History." But if the "Yü-kung" geography was written four thousand years ago, which is known by internal evidence, this being a part of the "Book of History," that whole work may be accepted by us, as it was by Confucius and Mencius, as a collection of true records of the history of the country in the old days, as far back as the time of Abraham and Moses.—North China Herald.

SALICYLIC ACID AS A FOOD PRESERVATIVE.

"IT is well known to-day," says The Sanitarian, "that salicylic acid is a powerful antiseptic. As such it retards the action of organized ferments like the yeast plant and putrefactive bacteria. It hinders and prevents fermentation, the souring of milk and the putrefaction of milk. Its action upon unorganized ferments is even more powerful. It completely arrests the conversion of starch into grape sugar by disease and pancreatic extracts. This action is directly opposed to the process of digestion, and, were there no other reason, the use of salicylic acid should be universally condemned. These facts in connection with salicylic acid have been recognized very thoroughly in legislation. The use of the acid has been condemned by most of the European countries having pure food laws. In France it is forbidden by law. In Austria, Italy, and Spain it cannot be used without the danger of incurring a heavy penalty, and all South American states having pure food laws have absolutely forbidden its sale. The laws of many of the States forbid its use. By a decision of Mr. Wells, the dairy and food commissioner, the use of salicylic acid in food is prohibited in Pennsylvania. I wish to call attention here to another fact in connection with the use of salicylic acid which is of extreme importance, viz., the sale of preservalines, preservatives, etc., under various high sounding names, intended for use in private families. A number of these claimed to be perfectly harmless are on the market, but actually contain salicylic acid as the main ingredient. The conscientious and careful housekeeper should put an absolute veto upon the use of any such compound. There is rarely any need for them, since, when pure fruits and vegetables are used and the proper directions for sterilizing by heat, etc., are carried out, canned or preserved goods of all descriptions can be prepared that will remain in good condition for years without the aid of any preservative."

THE
Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.